D

4. The sump pump in the pit, pumps the dirty water through a hydroclone which separates the solids out of the water into a decanter sludge box.
5. Sludge in the main pit and decanter sludge box is periodically removed and disposed as a hazardous waste.
6. Dirty wash water is periodically removed and disposed as hazardous waste and replaced with fresh water.

Leachate Disposal System

Engineering plans for the leachate disposal system are provided in Attachment 14. The system includes:

1. Double containment from disposal cell to sanitary sewer
2. Double containment monitoring capability
3. Flow metering
4. Clean out capability
5. Underground storage capability

Electrical Distribution System

Engineering design drawings for electrical distribution at the site are in Attachment 14. Power is distributed from the wheel wash building to various locations on site to operate the air monitoring stations, discharge pumps, flow meters, etc.

System to Control Haul Road Run-Off

Operational procedures to minimize the likelihood of waste getting into the surface drains are utilized so as not to impact surface water quality. Such procedures include cleaning off the unloading vehicles prior to leaving the disposal cell, maintaining adequate daily cover in the unloading area so that vehicles are not exposed to the facility waste and maintaining haul roads by scraping up and disposing of any track out material.

System to Control Haul Road Run-Off (cont'd).

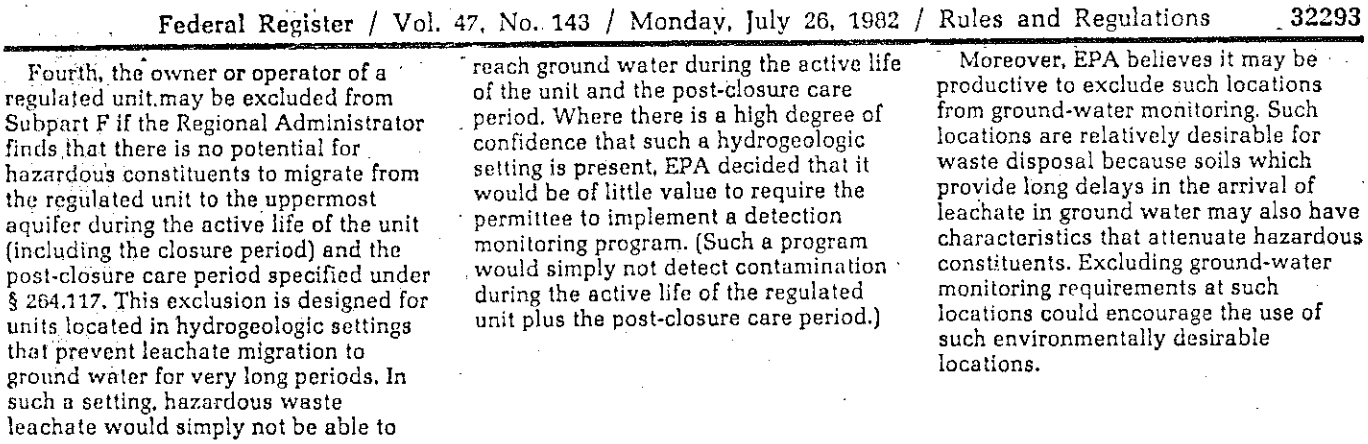
In addition to these procedures, a filter barrier will be staked along the road edge to prevent any potential track out material from uncontrollably entering the edgedrains in satisfaction of R299.9604. Material accumulated against the barrier will be removed on a regular basis for disposal. Run off from the haul roads over the past five years of facility operation has not impacted surface water quality according to the quarterly monitoring program.

Recordkeeping

Testing data and records that are required by the construction permit or operating license shall be kept in the facility operating notebook.

Section E -
Groundwater Monitoring

The waiver provision was developed specifically for facility site locations such as the Allen Park Clay Mine based on the following discussion published in the Federal Register.



Federal Register / Vol. 47, No. 143 / Monday, July 26, 1982 / Rules and Regulations 32293

Fourth, the owner or operator of a regulated unit may be excluded from Subpart F if the Regional Administrator finds that there is no potential for hazardous constituents to migrate from the regulated unit to the uppermost aquifer during the active life of the unit (including the closure period) and the post-closure care period specified under § 264.117. This exclusion is designed for units located in hydrogeologic settings that prevent leachate migration to ground water for very long periods. In such a setting, hazardous waste leachate would simply not be able to reach ground water during the active life of the unit and the post-closure care period. Where there is a high degree of confidence that such a hydrogeologic setting is present, EPA decided that it would be of little value to require the permittee to implement a detection monitoring program. (Such a program would simply not detect contamination during the active life of the regulated unit plus the post-closure care period.)

Moreover, EPA believes it may be productive to exclude such locations from ground-water monitoring. Such locations are relatively desirable for waste disposal because soils which provide long delays in the arrival of leachate in ground water may also have characteristics that attenuate hazardous constituents. Excluding ground-water monitoring requirements at such locations could encourage the use of such environmentally desirable locations.

October 10, 1985
ATTACHMENT 15

Ford Motor Company

Allen Park Clay Mine Landfill

E.P.A. I.D. No. MID 980568711

Demonstration for Exemption of Subpart F Requirements
Under 40 CFR 264.90 (b) (4) and 40 CFR 265.90 (c)

Demonstration is hereby made to waive certain groundwater monitoring requirements as provided for under 40 CFR 264.90 (b) (4) and 40 CFR 265.90 (c) of the RCRA rules, based on the favorable site geology to the aforementioned rules. Specifically, the requested exemption includes all sampling of the artesian aquifer immediately below the insitu saturated clay liner.

Site Description

Depositional Environment:

The site hydrology is governed by the last glacial period in which the Huron-Erie ice lobe occupied southeast Michigan as shown on Exhibit A. When the ice lobe retreated, a proglacial lake (Lake Maumee) formed, as shown on Exhibits B and C. The site vicinity is located at least 16 miles from the shores of this lake. The clay sediments deposited in the site vicinity reflect this low energy depositional environment. The lacustrine clay is generally 80-120 feet in thickness and has become an effective aquiclude since the recession of the lake. The recharge area for the underlying aquifer is the moraine and outwash complex to the northwest and the underlying Devonian carbonate formations. There are no groundwater withdrawal wells within a three mile radius of the facility.

Artesian Aquifer:

The confined aquifer is located approximately 70 feet below the existing grade at the Allen Park site and varies in thickness from one to six feet. It exerts an upward hydrostatic pressure on the clay aquiclude equivalent to 80 feet of head. This hydraulic gradient in the upward direction is a counteracting force against those of leachate migration (drag coupling effect and chemico-osmotic diffusion). Under these conditions, there is no potential for migration of liquid from the regulated unit to the uppermost aquifer during the active life of the regulated unit and the post-closure care period. Refer to Exhibit D for a full discussion on leachate migration at the facility.

Subsurface Soil Conditions:

The uniformity of the clay sediments in the Detroit area (Erie-St. Clair Plain) has been documented by the numerous soils exploration and foundation engineering studies required for all of the building and construction projects in the vicinity.

To be site specific, the following documentation has been established:

1) Clay mining operations, excavating clay for the manufacture of cement, have encountered more than 45 feet of uniform material over the entire site.

2) Seismic work on the cell bottom indicates that the bedrock is between 57 and 70 feet below the cell bottom with uniform material to that depth. Refer to Exhibit E.

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3) Soil samples taken from the five most recent borings indicate the clays are saturated to the surface from the artesian aquifer. Refer to Exhibit F.

4) Soil tests performed (grain size analysis, atterberg limits and permeability) on the clay provided more than adequate uniformity. Refer to Exhibit G.

5) The 12 deep borings indicate uniform soil conditions. Refer to Exhibit H.

6) The deep monitor wells into the artesian aquifer provide piezometric surface elevations that are consistent with the regional data which conclude that ground surface is below the piezometric surface. Refer to Exhibit H.

7) Additional studies, maps, and tests relating to subsurface conditions at the site indicate that subsurface clay is in excess of 25 feet thick with a permeability coefficient which is no greater than 6.0×10^{-8} cm/sec. In addition, the underlying artesian aquifer exerts hydrostatic pressure in an upward direction which precludes the possibility of leakage from the cell into the liner during the active life of the disposal facility. Refer to Exhibit H.

8) Water balance of precipitation, evapotranspiration, runoff and infiltration Refer to Exhibit I.

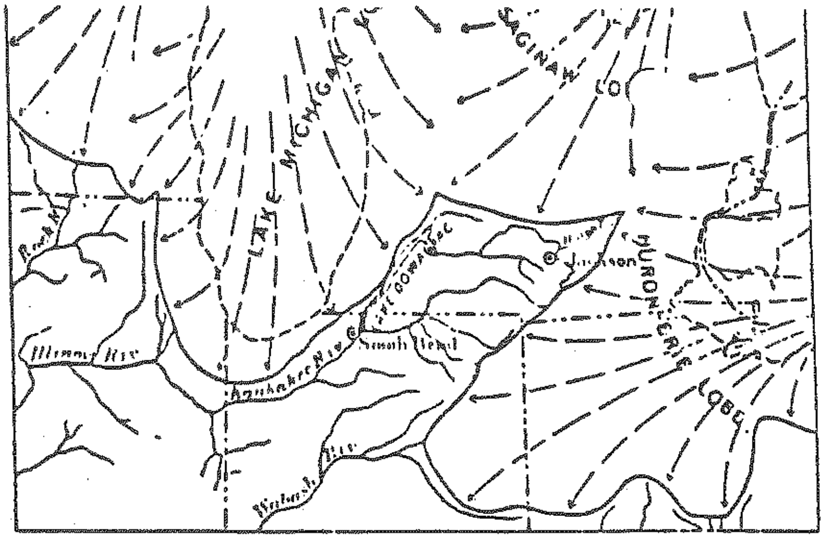
9) Additional geological information is provided by W. H. Sherzer, "Geological Report on Wayne County", Publication 17, Geological Series 9, 1913.

Summary:

Under the conditions stated in this demonstration, there is no potential for migration of liquid from the regulated unit to the uppermost aquifer during the active life of the regulated unit and the post-closure care period. The monitoring of water quality in the artesian aquifer cannot possibly detect leachate migration from the overlying disposal site. Accordingly, it is therefore believed that the Allen Park Clay Mine Landfill qualifies for the groundwater monitoring waiver set forth under the applicable regulations.

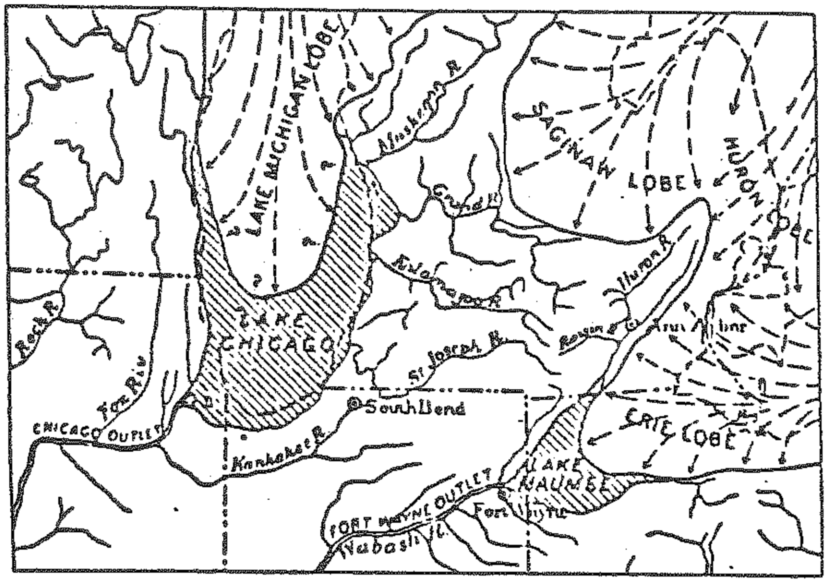
Prepared by: David S. Miller, Geologist
Mining Properties Department
Rouge Steel Company
(University of Michigan B.S. 1977)

EXHIBITS A, B, C



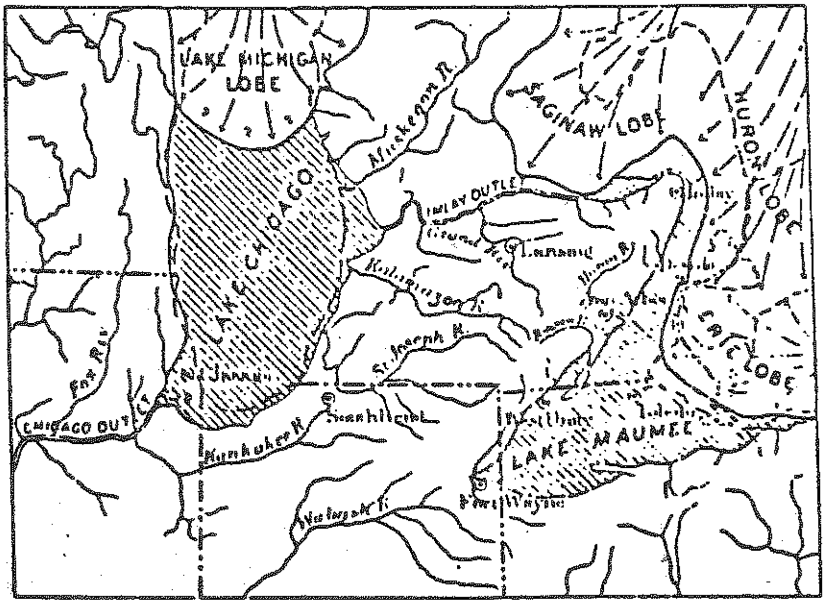
LAKE MICHIGAN
SAGINAW LO
HURON-ERIE LOBE
Jackson
South Bend
Kankakee Riv
Illinois Riv
Rock R
Wabash Riv

EXHIBIT A (Map from Frank Leverett)



LAKE MICHIGAN LOBE
SAGINAW LOBE
HURON LOBE
ERIE LOBE
LAKE CHICAGO
LAKE MAUMEE
Muskegon R
Grand R
Kalamazoo R
Huron R
St Joseph R
Ann Arbor
South Bend
Fort Wayne
Rock R
Fox Riv
CHICAGO OUTLET
Kankakee R
FORT WAYNE OUTLET
Wabash R

EXHIBIT B (Map from Frank Leverett)



LAKE MICHIGAN LOBE
SAGINAW LOBE
HURON LOBE
ERIE LOBE
LAKE CHICAGO
LAKE MAUMEE
Muskegon R
IMLAY OUTLET
Grand R
Lansing
Kalamazoo R
St Joseph R
South Bend
Fort Wayne
Fox Riv
CHICAGO OUTLET
Kankakee R
Wabash R

EXHIBIT C (Map from Frank Leverett)

Exhibit D

Report Prepared for:

Wayne Disposal, Inc.

CONTAINMENT INTEGRITY OF ALLEN PARK CLAY MINE/LANDFILL

by

Donald H. Gray
Professor of Civil Engineering
The University of Michigan

Ann Arbor, Michigan

July 1983

SUMMARY

The possibility of leachate migration downward from the Allen Park Clay Mine/Landfill and contamination of an aquifer beneath were evaluated.

Analyses show that density differences between the leachate and groundwater will not cause a downward migration nor will they lead to a diffusion efflux from the site. A thick, uniform layer of silty clay beneath the site coupled with an upward hydraulic gradient effectively precludes the latter.

Comparison with results of salt water intrusion studies across clay aquitards having similar properties as the clay beneath the Allen Park site show that the solute (salt) will take at least 800 years to migrate across a clay barrier 30 feet thick under chemico-osmotic diffusion alone. A counter (or upward) hydraulic gradient will lengthen this breakthrough time even further.

There are insufficient amounts of organic compounds in the waste to affect the permeability of the clay. The probability of accelerated leachate migration through the underlying clay is not supported by the composition of the wastes and the nature of the clay nor by the findings of leachate permeability studies reported in the technical literature.

Under these circumstances any observed increases in contaminant levels of monitor wells in the aquifer underlying the site could more reasonably come from sources laterally upgradient from the site rather than the clay mine/landfill above the site.

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CONTAINMENT INTEGRITY OF ALLEN PARK CLAY MINE/LANDFILL

I. INTRODUCTION

The Ford Motor Company who operate the Allen Park Clay Mine/Landfill have recently petitioned to discontinue ground water monitoring of an aquifer located approximately 70 feet below existing grade at the site. The landfill is underlain by dense, lacustrine clay which behaves as an aquiclude or aquitard. At least 25 feet or more of residual clay thickness separates the bottom of the landfill from the underlying aquifer. The aquifer is under artesian pressure and exerts an upward hydrostatic pressure on the base of the clay aquitard equivalent to 80 feet of head. A general cross section or profile illustating these soil and hydrologic conditions at the site is shown in Figure 1.

Applicant maintains in his petition for discontinuance (EPA I.D. No. MIT 980568711) that monitoring is not necessary at the site because of a) the dense, uniform clay underlying the site which has a hydraulic permeability no greater than 6×10^{-8} cm/sec and b) the artesian pressure in the underlying aquifer which results in an upward hydraulic gradient across the overlying clay aquitard. Applicant claims that these site conditions will preclude the possibility of leachate migrating downwards out of the landfill and eventually contaminating the aquifer.

In response to this petition, the Wayne County Department of Public Health has raised several questions and concerns (letter form R.N. Ratz, Public Health Engineer, to B. Trethewey, Mining Properties Department, Ford Motor Company, 28 April 1983). The following concerns were raised in the letter:

1. The petition/report fails to address the possibility of leachate migrating down due to differences in densities of the leachate and groundwater.
2. The petition/report does not indicate if there are any organic constituents in the leachate that may increase the clay's permeability and permit downward movement.

The purpose of the present report is to respond to the above stated concerns. Additional information about the geohydrology of the site, about past containment/migration studies, and about the likely nature of the leachate and its effect on clay permeability are evaluated herein to determine the danger of landfill leachate migrating downwards from the site and reaching the underlying aquifer.

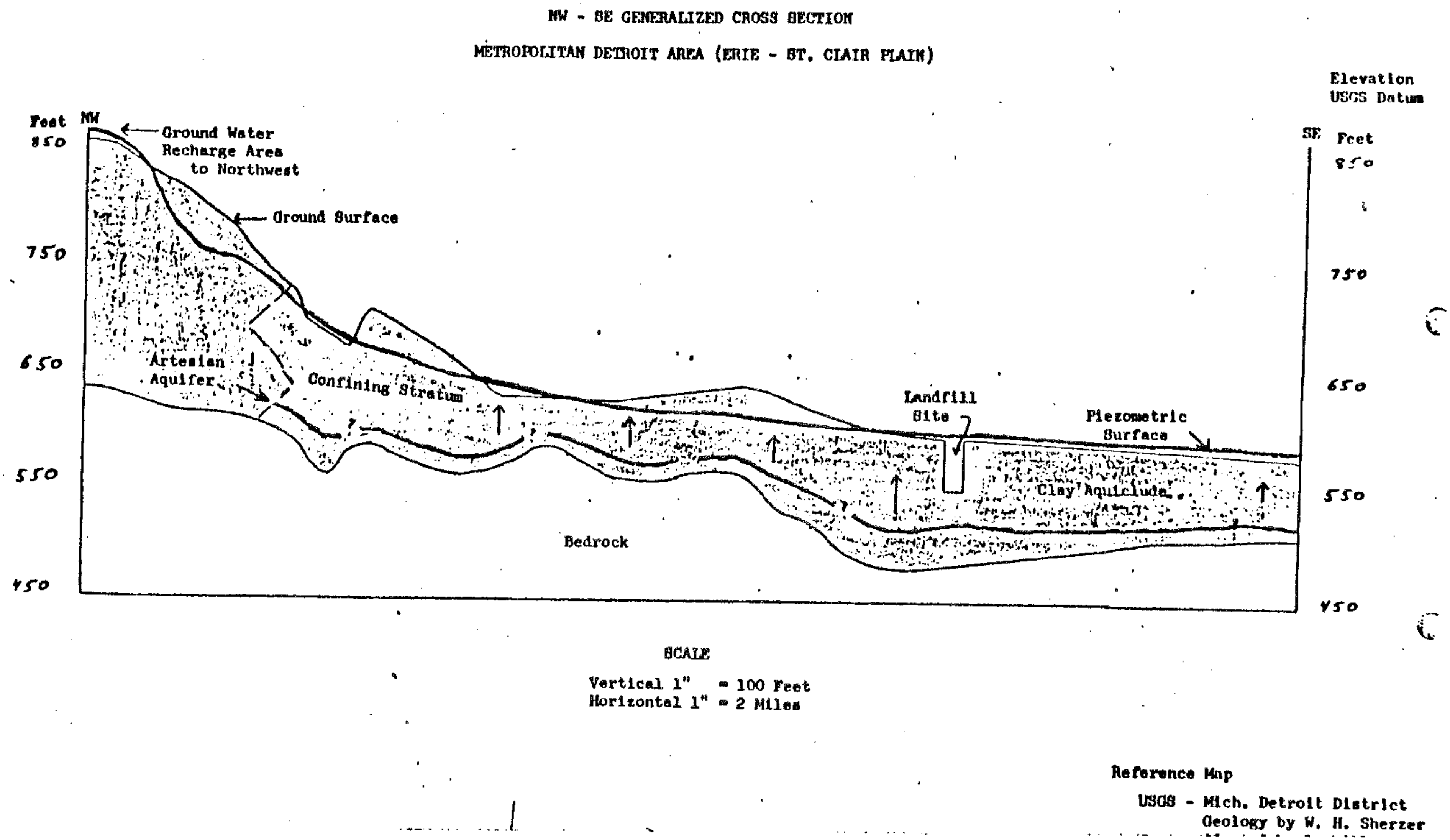
NW - SE GENERALIZED CROSS SECTION
METROPOLITAN DETROIT AREA (ERIE - ST. CLAIR PLAIN)
Elevation
USGS Datum
Feet
NW
850
Ground Water
Recharge Area
to Northwest
Ground Surface
750
650
Artesian
Aquifer
Confining Stratum
Landfill
Site
Piezometric
Surface
Clay Aquiclude
550
Bedrock
450
SE
Feet
850
750
650
550
450
SCALE
Vertical 1" = 100 Feet
Horizontal 1" = 2 Miles
Reference Map
USGS - Mich. Detroit District
Geology by W. H. Sherzer

Figure 1. Generalized cross-section through Allen Park Clay Mine/Landfill showing soil and hydrologic conditions.

II. THE INFLUENCE OF PERMEANT DENSITY ON LEACHATE MIGRATION ACROSS CLAY BARRIERS

A. GENERAL

Permeant density plays a direct and indirect role in flow phenomena in porous media. Permeant density can affect solvent or solution flow rates via its influence on hydraulic conductivity. This influence can be calculated and shown to be minor or insignificant compared to the more likely and important influence of permeant density on solute diffusion.

A newly introduced permeant with a high concentration of dissolved material (e.g., a leachate) will also have a higher density. This high concentration in turn will cause the solute to diffuse through a porous medium to regions of lower concentration. It is this manifestation or aspect of a density increase in the permeant that requires careful scrutiny and analysis. In other words, the role and influence of permeant density are more important to solute diffusion under concentration gradients as opposed to solvent (or solution) convection under hydraulic gradients.

The analyses that follow are offered in support of these claims.

B. INFLUENCE OF PERMEANT DENSITY INCREASE ON HYDRAULIC PERMEABILITY

Both the viscosity and unit weight of a permeant can influence the permeability of a soil to a particular permeant. The hydraulic conductivity is defined in this case as a flow velocity under a unit hydraulic gradient (the usual practice in civil engineering). The influence of permeant density and viscosity can be ascertained explicitly by defining another permeability, i.e., the "intrinsic" or "absolute" permeability

$$K = \frac{k \mu}{\gamma} \qquad (1)$$

where: k = hydraulic conductivity, cm/sec
K = intrinsic or absolute permeability, cm^2
γ = permeant density or unit weight, dynes/cm^3
μ = permeant viscosity, poise

The intrinsic permeability(K) is a property only of the solids or matrix through which the permeant passes. Accordingly, for a particular soil (i.e., given grain size distribution and soil structure) and in the absence of permeant-soil reactions, K should be a constant. The influence of a variation in viscosity and density of the permeant on the hydraulic conductivity can be determined from this fact and from a relationship derived from Equation 1, viz.,

$$k_2 = k_1 (\gamma_2/\gamma_1)(\mu_1/\mu_2) \qquad (2)$$

where: subscript 1 - initial conditions (grnd water)
subscript 2 - final conditions (leachate)

An increase in density of the permeant will apparently cause a higher permeability. But, this same increase in density can also result in an increase in viscosity which will reduce the permeability. Both influences together will tend to offset one another, and it is unlikely that a density increase in the permeant (leachate) will significantly affect hydraulic conductivity. Furthermore, even if viscous retardation is discounted, density increases are highly unlikely to significantly increase permeability in actual practice as the following example will show.

Assume the ground above an aquitard or clay barrier is flooded with a fairly concentrated brine solution, namely sea water. The density of sea water (with a TDS of 36,000 ppm) is 1.036 gm/cc at 4° C vs. the density of the present interstitial water (with an average TDS of 1550 ppm) which is 1.002 gm/cc. This leads to a density ratio of 1.034 which is equivalent to only a 3.4 per cent increase in hydraulic conductivity (discounting viscous retardation). Therefore, density has little effect on hydraulic conductivity despite the almost 20 fold increase in dissolved solids concentration. It is the influence of the latter change, i.e., the increase in dissolved solids concentration, that requires careful analysis in evaluating the effectiveness of a clay barrier in containing leachate migration in this case.

C. INFLUENCE OF PERMEANT DENSITY INCREASE ON SOLUTE DIFFUSION

1. Background

Dissolved solids or solutes in a permeant can be transported through soils under both hydraulic and concentration gradients. The former is referred to as "drag coupling" and the latter as "chemico-osmotic diffusion." Both types of movement should be considered when evaluating the effectiveness of a clay barrier for preventing leachate migration.

Chemico-osmotic effects in fine grained soils have been examined in some detail by Olsen (1969) and Mitchell et al.(1973). The importance of chemico-osmotic diffusion increases in fine grained soils wilth low hydraulic conductivities. Studies commissioned by the State of California(1971) on salt intrusion problems in aquifer-aquitard systems have shown that as aquitards become clay rich and their permeabilities fall to levels on the order of .002 gpd/ft^2 or 10^{-7} cm/sec, the migration of solutes will be controlled by chemico-osmotic diffusion.

2. Flow of Solute under Combined Hydr. and Chem. Gradients

Equations can be derived which describe the flows of solute and solution in the pores of a sediment. The derivation of these equations and assumptions on which they are based are given by Mitchell et al.(1973). The one-dimensional, vertical, steady state flux of solute across a clay aquitard under a combined salt concentration(chemical) gradient and hydraulic gradient is given by the following relationship:

$$J_s = [(\gamma_w/TR)c_s k_{ch} + c_s k_h]\,\partial h/\partial z + [\,D + c_s k_{ch}]\,\partial c_s/\partial z \qquad (3)$$

where: J_s = salt flux across an aquitard, moles/sec/cm^2
$\partial h/\partial z$ = hydraulic gradient (dimensionless)
$\partial c_s/\partial z$ = solute concentration gradient, moles/cm^4
D = diffusion constant, cm^2/sec
R = gas constant, ergs/mole/°K
γ_w = density of water, dynes/cc
T = absolute temperature, °K
c_s = average salt concentration, moles/cc
k_h = hydraulic conductivity, cm/sec
k_{ch} = chemico-osmotic coupling coefficient, cm^5/mole/sec

Relative contributions to the salt or solute flux can be calculated from Equation 3. Movement of solute can occur by diffusion whether a hydraulic gradient is present or not. A superposed hydraulic gradient may retard or accelerate movement of solute depending on:

a) Relative magnitude and direction of the hydraulic and solute concentration gradients.

b) Values of the hydraulic conductivity and chemico-osmotic coupling coefficient.

Equation 3 only yields the steady state flux of solute under combined hydraulic and chemical gradients. Equations can also be derived that give the initial or time dependent solute fluxes and the time required for "breakthrough" or first appearance of increased solute concentration on the downstream side of the aquitard. This initial, non-steady state process is quite complicated. Examples have been worked out for aquitards of different thicknesses and composition by Mitchell et al.(1973).

One of the most important findings of these studies on salt flux across clay aquitards was the importance of aquitard thickness on breakthrough time. Because the initial movement is non-steady, the breakthrough time increases with the square of the thickness of the aquitard. Theoretical studies of salt water intrusion across aquitards (State of California, 1971) have shown that salt ions will take up to 800 years to migrate across an aquitard 30 feet thick under chemico-osmotic diffusion alone. If the thickness is reduced to 10 feet, the breakthrough time decreases to only 80 years. The presence of an hydraulic gradient could either accelerate or retard this time depending on the relative magnitude and direction of this gradient and other factors cited previously (see Figure 3).

3. Likelihood of Solute Efflux Through Clay at Allen Park Site

Solutes will tend to migrate or diffuse downward from the landfill along a concentration gradient. On the other hand, this movement can be impeded or even arrested by the upward hydraulic gradient as a result of artesian pressure in the underlying aquifer. Static water levels in monitor wells around the landfill show that the piezometric surface is almost 10 feet above existing grade or ground surface elevation at the site (see Table 1). The net, steady state flux of solute, if any, can be determined under these conditions from the solute flow equation cited previously (Equation 3).

It is also pertinent to examine the results of a similar type of study commissioned by the State of California (1971). The latter study was designed to determine salt efflux rates and breakthrough times in an aquitard-aquifer system in the coastal ground water basin near Oxnard, California (see Figure 2). The problem posed in the California study was basically the same as the pre-sent one; namely, given a sudden increase in dissolved solids or solute concentration atop a clay barrier (or aquitard) how long before the salt migrated downward and reached an underlying aquifer and at what rates of efflux? The problem was compounded in the California example as a result of drawdown of the piezometric surface in the underlying aquifer which also caused a downward hydraulic gradient.

The two aquitards are quite similar in their important respects. Both are approximately the same thickness, have the same initial dissolved solids concentration, and are composed of clayey sediments with low hydraulic conductivities. The salient charateristics and parameters of these two aquitards are summarized and compared in Table 2. The main difference appears to be in their respective hydraulic conductivities--the Allen Park clay is an order-of-magnitude lower.

A dissolved solids concentration equal to that of sea water was assumed in the leachate overlying the Allen Park clay. Sea water is a good "worst case" choice because sodium ions have high diffusion mobilities and are not preferentially adsorbed on clay exchange sites as heavy

TABLE 1. ALLEN PARK CLAY MINE

MONITOR WELL - WATER LEVEL READINGS

Well Number	Ground Elevation, Ft.	Well Elevation[(1)] USGS	Ground Water[(2)] Elevation 11-4-81	Δ	Ground Water[(3)] Elevation 5-29-81	Ground Water[(3)] Elevation 3-26-81
2	595.1	600.76	600.67	5.6	600.44	600.21
5	595.7	605.92	605.09	9.4	604.62	604.49
7	594.1	597.35	591.01	-3.1	593.23	594.14
10	593.4	603.03	601.81	8.4	601.93	601.56
W-101	593.9	601.47	601.21	7.3		
W-102	591.3	600.81	603.22(4)	11.9		
W-103	593.9	605.06	603.52	9.6		
W-104	594.1	603.82	603.81	9.6		
W-105	594.5	604.08	603.86	9.4		

$\Delta_{AV} = 8.9$

(1) Well Elevation is recorded as top of standpipe.

(2) Data Recorded by Michigan Testing Engineers, Inc.

(3) Data obtained from Michigan Department of Natural Resources.

(4) Well extended temporarily to obtain water level.

TABLE 1

TABLE 2. COMPARISON OF AQUITARD PROPERTIES AND SITE PARAMETERS

AQUITARD PROPERTY OR SITE PARAMETER	OXNARD CALIFORNIA	ALLEN PARK MICHIGAN
Composition	clayey silt & silty clays	silty clay
Thickness, ft	30	25 - 35
Ave. Water Content, %	24	20
Ave. Liquid Limit, %	31	28
Ave. Hydraulic Conduct, cm/sec	1×10^{-7}	2.6×10^{-8}
Hydraulic Gradient	0.33 - 1.0 (downward)	2.7 (upward)
Initial (interstitial) Pore Water Solute Conc, ppm	1800	1550
Final Solute Conc, ppm	36,000	36,000 (assumed)
Chemico-Osmotic Coupling Coefficient, cm^5/mole/sec	6.2×10^{-4}	6.2×10^{-4}

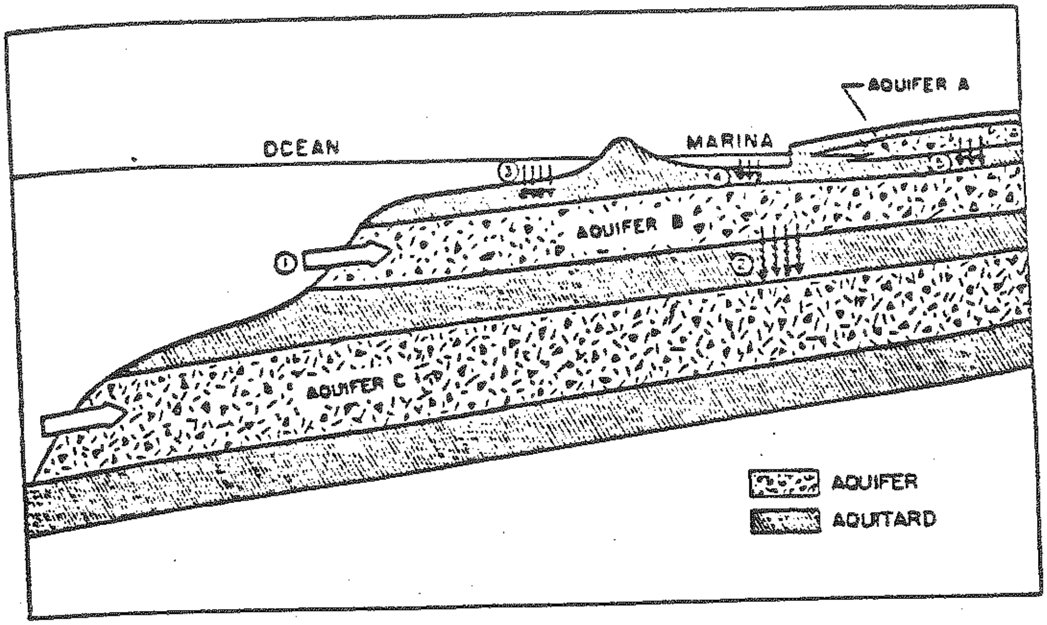
AQUIFER A
OCEAN
MARINA
③
④
⑤
①
②
AQUIFER B
AQUIFER C
AQUIFER
AQUITARD

Figure 2. Generalized cross-section of multiple aquifer in a coastal basin. Salt flux across aquitard can occur as result of either salt water intrusion into aquifer (1,2) or salt water entering directly above aquitard in shallow coastal waters or marinas (3,4), or from salt contamination in near surface, perched aquifer (5).

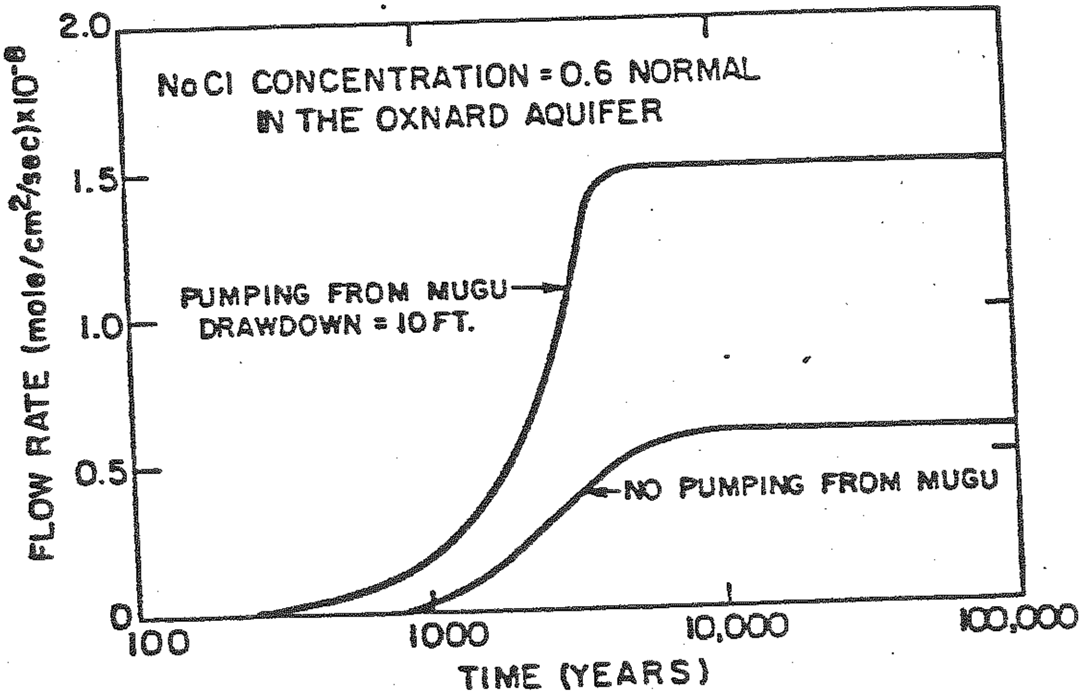

Figure 3. Solute efflux across aquitard into underlying aquifer as a result of salt water intrusion in overlying aquifer. Aquitard is 30 feet thick and has a hydraulic conductivity of 10^{-7} cm/sec. Pumping from lower (Mugu) aquifer superposes a 0.33 downward gradient on system.

metal ions would tend to be. The same chemico-osmotic coupling coefficient used in the California aquitard was also assumed applicable for the Allen Park clay. The value used is reasonable for the type of clay sediments present.

Results of the California study are presented in Figure 3 which shows the salt influx into the underlying aquifer as a function of time. Curves are presented for a no drawdown and 10-foot drawdown case (assuming the hydraulic gradient acts in the same direction as the salt concentration gradient). The horizontal portion of the two curves represents the steady state salt flux.

The main things to notice from this figure are the large breakthrough time (800 years) for the "no drawdown" case (i.e., in the absence of any hydraulic gradients) and the fact that in this aquitard the salt flux caused by drag coupling under a hydraulic gradient is larger. The steady state salt flux from the drag coupling under a combined 10-foot drawdown and salt concentration gradient is almost three times that from diffusion alone (no drawdown). Hence, in the event the hydraulic gradient was reversed, there would be no breakthrough and no downward salt flux provided the upward gradient exceeded about 0.2. In other words, under these conditions the two salt fluxes would be mutally opposed and exactly counterbalanced.

The relative contributions to steady state efflux in this example can be calculated with the aid of Equation 3. The following parameter values (taken from the study) were used in the calculation:

$$\partial h / \partial z \approx \Delta h / \Delta L = 10/30 = 0.33$$

$$\partial c / \partial z \approx (c_{s_2} - c_{s_1})/\Delta L = \frac{0.57 \times 10}{914} = 0.62 \times 10 \text{ moles/cm}^4$$

$$c_s = (c_{s_2} + c_{s_1})/2 = \frac{(0.60 - 0.03) \times 10}{2} = 0.32 \times 10 \text{ moles/cm}^3$$

$D = 10^{-5}$ cm^2/sec

$R = 8.32 \times 10^7$ ergs/mole/°K

$T = 300$ °K

$\gamma_w = 10^3$ dynes/cc

$k_h = 10^{-7}$ cm/sec

$k_{ch} = 6.2 \times 10^{-4}$ cm^5/mole/sec

Using these values the calculated contributions to steady state solute flux are respectively:

Drag Coupling:

$$J_{s_1} = [(\gamma_w/RT)c_s k_{ch} + c_s k_h] \partial h/\partial z$$

$$= \left\{\frac{10^{3}(2\times10^{-7})}{[8.32\times10^{7}(.3\times10^{-3})} + 0.32\times10^{-3}(10^{-7})\right\} 0.33$$

$$= 1.056 \times 10^{-11} \text{ moles/sec/cm}^2$$

$$= \underline{0.98 \times 10^{-8} \text{ moles/sec/ft}^2}$$

Chemico-Osmotic Diffusion:

$$J_{s_2} = [D + c_s k_{ch}] \partial c_s/\partial z$$

$$= [10^{-5} + 2\times10^{-7}]\, 0.62\times10^{-6}$$

$$= 0.63 \times 10^{-11} \text{ moles/sec/cm}^2$$

$$= \underline{0.58 \times 10^{-8} \text{ moles/sec/ft}^2}$$

The total salt flux is the sum of the contributions from drag coupling and chemico-osmotic diffusion or

$$J_s = J_{s_1} + J_{s_2}$$

$$= (0.98 + 0.58) \times10^{-8}$$

$$= \underline{1.56 \times 10^{-8} \text{ moles/sec/ft}^2}$$

These calculations are in agreement with the results shown in Figure 3 for steady state salt inflow under combined gradients. They also illustrate that the drag coupling contribution under a 10-foot drawdown (0.33 hydraulic gradient) exceeds the chemico-osmotic diffusion contribution.

In the case of the clay aquitard beneath the landfill at Allen Park, the average hydraulic conductivity is almost an order-of-magnitude lower (2.6×10^{-8} vs. 10^{-7} cm/sec). This will tend to decrease the drag coupling. On the other hand, this tendency will be more than offset by higher hydraulic gradients at this site. If the level of the leachate is kept at or close to the bottom of the landfill, then the gradient will approach 80/30 or 2.7. The drag coupling component of solute flux in this case will be

$$J_{s_1} = \left[\frac{10^{3}(2\times10^{-7})}{[8.32\times10^{4}(.3\times10^{-3})} + 0.32\times10^{-3}(2.6\times10^{-8})\right] \times 2.7$$

$$= [0.008\times10^{-12} + 0.832\times10^{-11}] \times 2.7$$

$$= 2.25 \times 10^{-11} \text{ moles/sec/cm}^2$$

$$= \underline{2.09 \times 10^{-8} \text{ moles/sec/ft}}$$

This flux is greater than 3X the chemico-osmotic flux; and since it acts in the opposite direction, there will be no net downward flux of solute at the Allen Park site. The critical hydraulic gradient to maintain a zero net salt efflux is 0.8. This means that the groundwater table could rise to within 12 feet of present ground elevation (~595 ft) in the landfill and there would still be a sufficient upward hydraulic gradient (drag coupling effect) to completely counter solute efflux under chemico-osmotic diffusion (see summary below).

Position of Ground Water Table in the Landfill	Upward Hydraulic Gradient	Net, Steady State Solute Efflux Rate (moles/sec/ft^2)
At bottom	2.7	-1.51×10^{-8} (net influx)
12 feet from top	0.8	zero
At top	0.33	$+0.32 \times 10^{-8}$

These calculations are based on the existence of a static or piezometric head in the underlying aquifer approximately 9-10 feet above ground elevation (see Table 1).

Assumption of worst case conditions, namely, a rise in the groundwater table in the landfill to ground surface elevation, leads to a small, steady state efflux rate from chemico-osmotic diffusion. This occurs because the resulting hydraulic gradient (0.33) is no longer large enough to completely oppose the chemico-osmotic salt flux. The breakthrough times, however, would be so immense (1000's of years) that the steady state flux under these conditions is largely irrelevant.

It is important to note that the preceding calculations are also based on the following "worst case" assumptions:

1. A highly saline leachate with a concentration and composition equal to that of sea water.

2. No interaction between the solute and clay.

In actual practice, there would be some uptake and adsorption of solutes on the clay. This adsorption would attenuate or limit further solute concentrations in the leachate as it passed through the clay.

III. EFFECT OF LEACHATE CONSTITUENTS ON THE PERMEABILITY OF CLAY

A. GENERAL BACKGROUND

The possibility that leachate--either in the solvent or solute phase--might affect clay permeability and hence its containment integrity has been raised by a number of investigators (Anderson and Brown, 1981; Haxo, 1981; and Folkes, 1982). One of these studies has shown that concentrated organic liquids can increase clay permeability by several orders-of-magnitude (Anderson and Brown, 1981).

All of these studies were conducted in the laboratory with simulated leachates from particular types of wastes and under particular testing conditions. The danger of blindly applying these test results to a field situation have been noted recently by Gray and Stoll (1983). It is essential to ask the following before the results of these lab tests can be applied to a given field situation:

1. What was the nature of the leachate in the lab tests? What are the concentrations of various constituents in the leachate in the field as opposed to the lab tests? How relevant are the lab test results in the light of potentially large differences in leachate composition (lab vs. field)?

2. How did the leachate contact or interact with the clay in the lab tests? Was it forced through? If so, at what gradient? Is there any prospect that the leachate will be able to penetrate/permeate through the clay containment in the field in like manner? In other words are the necessary gradients and other conditions present to permit this to happen?

3. What was the failure or clay degradation process by which the apparent permeability increase occured in the lab tests? Was it by a) dissolution, b) syneresis, c) piping? Could these mechanisms reasonably occur in the field given the type, water content, and density of the in-situ clay plus the nature and concentration of organic and inorganic compounds in the leachate?

B. WASTE AND LEACHATE COMPOSITION AT THE ALLEN PARK CLAY MINE

The types, composition, and relative amounts of wastes placed in the Type II Solid Waste Landfill at Allen Park are shown in Tables 3 and 4. The results of typical E.P.T leachate tests on these wastes are shown in Table 5. The likely nature and composition of the landfill leachate can be estimated from this information. This estimate is adequate for purposes of evaluating the probable effect of the leachate on clay permeability.

TABLE 3. ALLEN PARK CLAY MINE - SOLID WASTE LANDFILL CONSTITUENTS

Fly Ash	-	50%
Blast Furnace Filter Cake	-	15%
Construction Debris - Sweepings - Clean-Up	-	14%
BOF Dust	-	6%
Foundry Sand	-	6%
Electric Furnace Dust	-	4.8%
Coal and Coke	-	3%
Coke Oven Decanter Tar Sludge	-	0.6%
Glass	-	0.5%
Wood Ash	-	0.5%
BOF Kish	-	0.3%
Wastewater Treatment Sludge	-	0.2%
Grinding Mud	-	0.1%

TABLE 4. ALLEN PARK CLAY MINE WASTES. TYPICAL AS RECEIVED ANALYSES (mg/kgm).

	Decanter Tank Tar Sludge	Electric Arc Furn. Dust	Blast Furn. Flue Dust	BOF Flue Dust	Blast Furn. Filter Cake	Foundry Sand	BOF Kish	Fly Ash	Lime Dust	Coke Breeze
EP Toxic	No	Yes(Zn,Pb,Cd)	No	No	No	No	No	Exempt	No	No
Iron	----	350,000	122,000	560,000	150,000	1,200	490,000	34,500	----	5,000
Carbon	----	4,700	520,000	7,400	404,000	6,600	240,000	194,000	----	590,000
Arsenic	----	50	19	42	2	20	70	----	----	15
Barium	----	<1	<1	<1	20	<1	<1	----	----	<1
Cadmium	----	95	<1	50	8	<1	<1	----	----	<1
Chromium	----	500	<1	130	70	<1	60	----	----	1
Lead	----	<4,500	<1	3,000	350	44	<1	----	----	69
Mercury	----	<1	<1	<1	<1	<1	<1	----	----	<1
Selenium	----	120	90	<1	<1	35	70	----	----	3
Silver	----	6	<1	<1	9	<1	<1	----	----	19
Manganese	----	39,000	7,500	10,000	4,500	79	2,800	----	----	70
Zinc	----	150,000	120	22,000	400	40	194	----	----	110
Phosphorus	----	450	200	190	300	400	170	----	----	90
Sulfur	----	3,600	4,000	1,600	4,000	200	350	3,100	----	7,300
Calcium	----	61,000	18,000	2,000	20,000	60	500	13,100	714,700	350
Magnesium	----	11,000	7,500	9,600	13,000	100	3,000	5,400	----	300
Aluminum	----	2,400	2,200	<2	3,700	<2	1,600	147,200	----	<2
Silicon	----	15,000	20,000	8,000	83,000	450,000	25,000	201,700	----	20,000
Potassium	----	5,900	980	5,000	2,200	170	640	9,700	----	220
Sodium	----	5,200	440	2,300	1,500	390	630	3,700	----	650
Fluorine	----	26	10	23	4	<1	48	----	----	<1
Cyanide	14	<1	<1	<1	3	<1	<1	----	----	2
Phenol	1,800	<1	<1	<1	3	<1	2	----	----	3
Naphthalene	2,700	----	----	----	----	----	----	----	----	----

TABLE 5. ALLEN PARK CLAY MINE SOLID WASTES TYPICAL E.P.T. LEACHATE TEST RESULTS (Mg/1)

Parameter	Blast Furnace Flue Dust	BOF Flue Dust	Blast Furnace Filter Cake	Foundry Sand	BOF Kish	Coke Breeze	Wastewater Treatment Sludge
Arsenic	0.04	0.02	< 0.1	0.03	0.1	<0.1	.008
Barium	<0.8	<0.04	< 0.8	<0.08	< 0.8	<0.8	.45
Cadmium	0.01	0.03	< 0.08	<0.005	<0.005	<0.005	.005
Chromium	< 0.1	< 0.05	< 0.05	< 0.1	< 0.1	<0.1	.101
Lead	< 0.2	1.7	1.7	<0.2	<0.2	<0.2	.025
Mercury	0.0007	< 0.01	< 0.2	<0.2	<0.2	<0.2	.0005
Selenium	1.0	< 0.01	< 0.2	0.10	0.4	<0.5	.008
Silver	< 0.1	< 0.01	< 0.01	<0.1	< 0.1	<0.1	.004

Compiled By [illegible]
March 1, 19[illegible]

The data in Tables 3 and 4 indicate that 50 per cent of the solid waste consists of relatively inert fly ash and that some 89 per cent of the wastes consist of materials that do not contain significant amounts of heavy metals (Zn, Pb, Cd) or organics known or suspected to be toxic such phenol and naphthalene (see Table 4). The coke oven decanter tar sludge is a possible source of organics (phenol and napthalene), but this waste comprises only 0.6 per cent of the total stream in the Type II Solid Waste landfill.

C. PROBABILITY OF ORGANICS IN LEACHATE AFFECTING CLAY PERMEABILITY AT ALLEN PARK SITE

Anderson and Brown (1981) found that several organic liquids, viz., aniline, acetone, ethylene glycol, heptane, and xylene, cause large increases in permeability of four compacted clay soils. Pure organic liquids were used in their study. One of the authors (Anderson, 1982) later emphasized that their results cannot be used to support claims that clay liners permeated by dilute organic liquids may be susceptible to large permeability increases.

Haxo (1981) reported results of up to 52 months of liner exposure to selected industrial wastes. He included several organic wastes, namely, aromatic oil, Oil pond 104, and a pesticide. The results of large permeameter tests on a compacted fine-grained soil and admixed materials are summarized in Table 6. Although a small amount of seepage passed through the compacted, fine-grained soil liner, no permeability increases were reported with any of the organic wastes.

On the basis of these studies and with the caveats noted at the beginning of this section in mind, it is possible to evaluate the likely effect of the landfill leachate on clay permeability at the Allen Park site.

1. Type II Solid Waste Landfill

As noted previously the existing landfill contains small quantities of coke oven decanter tar sludge which is a possible source of organics (phenol and naphthalene), but this waste comprises only 0.6 per cent of the total. Phenol and naphthalene are present in the tar component of this waste in concentrations estimated by Desha (1946) of 0.1 and 2.2 per cent by weight respectively. Accordingly, the amount of phenol and naphthalene present in the total waste stream are .006 and .013 per cent by weight respectively. These amounts constitute a very low fraction and they suggest that leachate from the total waste stream will tend to have very low concentrations of phenol and napthalene. Therefore, the organics in the leachate from the Type II Solid Waste landfill are quite unlikely to affect clay permeability.

TABLE 6. EFFECTS OF INDUSTRIAL WASTES ON SOIL AND ADMIX LINERS (from Haxo, 1981)

Liner material	Acidic waste (HNO_3, HF, HOAC)	Alkaline waste (spent caustic)	Lead (low lead gas washing)	Oily waste		Pesticide (weed killer)
				Aromatic oil	Oil pond 104	
Compacted fine-grained soil 305 mm thick	Not tested	Measurable rate of seepage $v_s = 10^{-10}-10^{-9}$ m/s, waste penetrated 3–5 cm after 30 months (*a*)		$k = 1.8 \times 10^{-10}$ $k = 2.4 \times 10^{-10}$ $k = 2.6 \times 10^{-10}$ (tests on soil after 30 months)	†	†
Soil cement 100 mm thick	Not tested	No measurable seepage after 30 months				
Modified bentonite and sand (2 types) 127 mm thick	Not tested	Measurable seepage after 30 months, channelling of waste into bentonite (*b*)			Failed (waste seepage through liner)	‡
Hydraulic asphalt concrete 64 mm thick	Failed	Satisfactory	Waste stains below liner asphalt mushy	Not tested	Not tested	Satisfactory
Spray-on asphalt and fabric 8 mm thick	Not tested	Satisfactory	Waste stains below liner	Not tested	Not tested	Satisfactory

*From data presented by Haxo (1981).

†Same as (*a*).

‡Same as (*b*).

2. Type I Hazardous Waste Landfill

In the future the decanter tar sludge will be placed in a separate landfill that will be upgraded to accept hazardous wastes. This action will increase the relative proportion of organics (phenol and naphthalene) in the waste stream. Leachate tests run on pure samples of decanter tar sludge using a distilled water extraction procedure (Calspan, 1977) have produced phenol concentrations of approximately 500 ppm. Even this concentration is far removed from the very high concentrations of organic solvents used by Anderson and Brown (1981) in their permeability tests on different clays. Accordingly, organics in the leachate from the Type I Hazardous Waste landfill are also unlikely to affect clay permeability.

In summary: It does not appear likely nor reasonable that organics present in the wastes at the Allen Park Clay Mine/Landfill will cause a permeability increase given their low concentration and the absence of any substantiation in the published technical literature for such an increase under these conditions.

IV. CONCLUSIONS

(1). There appears to be very little likelihood of leachate migrating downward from the Allen Park Clay Mine/Landfill and contaminating the aquifer beneath the clay.

(2). A density difference between the leachate and groundwater will have little or no influence on hydraulic permeability or downward migration nor will it lead to diffusion efflux of solutes. A thick, uniform bed of silty clay beneath the site coupled with an upward hydraulic gradient precludes the latter. Calculations and analyses are provided herein to support this finding.

(3). Comparison with results of salt water intrusion studies across clay aquitards having similar properties as the clay beneath the Allen Park Clay Mine site show that the solute (salt) will take at least 800 years to migrate across a clay barrier 30 feet thick under chemico-osmotic gradients alone. A counter (or upward) hydraulic gradient will increase this breakthrough time even more.

(4). The waste and its leachate are unlikely to increase the permeability of the underlying clay. This claim is reasonable in view of the low concentrations of organics in the total waste stream and in the light of the findings and caveats of permeability/exposure tests with organic permeants reported in the technical literature. This conclusion applies to both the existing Type II Solid Waste landfill and a proposed Type I Hazardous Waste landfill that will accept the coke oven decanter tar sludge.

(5). The composition of the waste and underlying clay do not suggest properties or combination of properties that could lead to a containment failure caused by such processes as piping, acid/base dissolution, or syneresis.

(6). Under these circumstances any observed increase in contaminant levels of monitor wells in the aquifer underlying the site could just as well come from other sources laterally upgradient from the site rather than from the clay mine/landfill above the site.

(7). These findings and conclusions support the basis of applicant's petition for discontinuing further monitoring of the wells penetrating the aquifer beneath the site.

V. REFERENCES CITED

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JULY 1983 REPORT
CONTAINMENT INTEGRITY OF ALLEN PA
CLAY MINE / LANDFILL

1704 Morton Street
Ann Arbor, Michigan
48104

25 September 1983

Mr. Mark Young
Wayne Disposal Company
P.O. Box 5187
Dearborn, MI 48128

RE: Allen Park Clay Mine/Landfill

Dear Mark:

I recently wrote a computer program (*CLAYWALL*) that can be used to calculate solute transport across a clay barrier under combined diffusion and advection (hydraulic flow). The program computes the exit/source concentration ratio (C/Co) as a function of elapsed time (t) on the downstream side of a clay wall or barrier of thickness (X).

The program was written with a clay slurry cut-off wall in mind, but is general enough that it can be used with any clay layer or barrier. The input parameters to the program are:

D_e = efffective diffusion coefficient, ft^2/yr
K = hydraulic permeability, ft/yr
X = thickness of wall or barrier, ft
P = porosity
I = hydraulic gradient....(+) if same direction, (-) if opposite direction to solute concentration gradient
t = elapsed time, yrs

The program is based on the solution to the equation that describes one-dimensional solute transport in a saturated porous medium under both hydraulic and solute concentration gradients. This equation has the following form:

$$C/Co = 0.5[\mathrm{erfc}((X-vt)/\mathrm{sqr}(4DK)) + \exp(vX/D)\ \mathrm{erfc}((X+vt)/\mathrm{sqr}(4DK))]$$

where: v = ave seepage velocity = (KI/P)

The solution assumes the following conditions:

1. Saturated, one-dimensional flow.

2. No reaction between solutes and porous medium. Chloride typically behaves this way.

3. Diffusion controlled, i.e., the pore water velocity is so low that mechanical mixing is negligible and the dispersion is equal to the effective diffusion coeffficient. (this condition is satisfied when K< 1.0E-07.

I ran the program using data for the silty clay layer underlying the Allen Park ClayMine/Landfill. The following values for the input data were used:

D = 0.102 ft^2/yr (6.3E-06 cm^2/sec)
(published value for clay tills)
K = 0.025 ft/yr (2.5E-08 cm/sec)
X = 30 ft
P = 30 %
I = -0.1, -0.3, and -1.0

The results of the analysis are shown in the attached graph. At a counter hydraulic gradient of -0.3 the exit/source solute concentration ratio does not exceed 0.0001 until 700 years have elapsed. You may recall that a counter hydraulic gradient of -0.3 occurs when the leachate is allowed to rise in the landfill to the ground surface...a worst case scenario. For larger (negative) counter hydraulic gradients the ratios become even smaller. In fact for I< -0.5 (i.e., counter hydraulic gradients larger than 0.5) the ratio C/Co is less than 1.0E-05 at all elapsed times.

These results confirm the findings of my earlier report which were based largely on analogy to solute transport studies in clay aquitards. The present findings are based on analysis of actual soil and site parameters. Keep in mind, also, that the analysis is still quite conservative because it neglects possible adsorption (reaction) of solutes with the clay.

A copy of the computer program and typical output are enclosed. It is written in BASIC and is designed to be run on a personal computer. If you have any questions about the analysis, please feel free to contact me.

Sincerely,

Donald H. Gray

Donald H. Gray
Professor of Civil Engineering

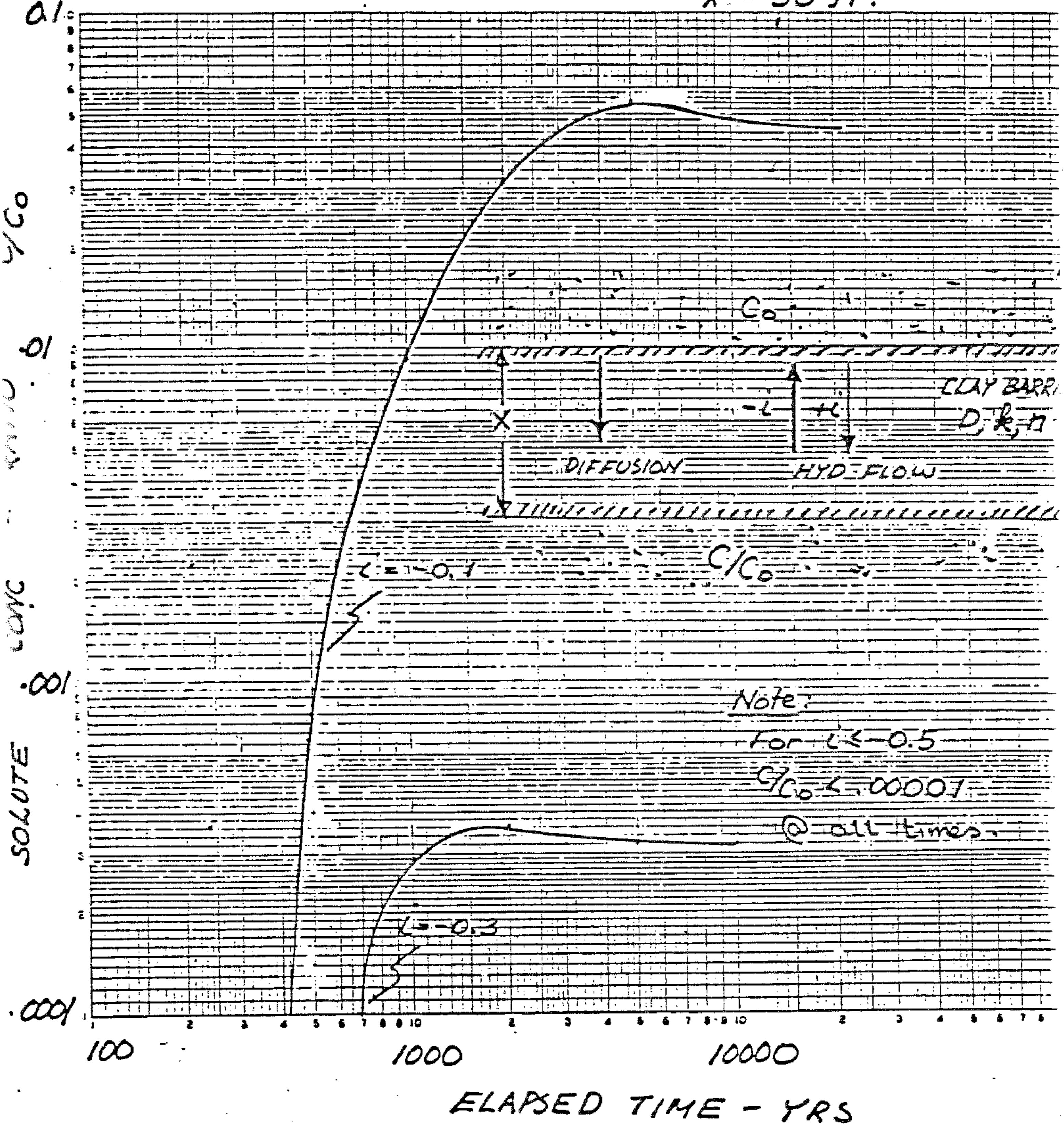
Encl

$D = 0.102\ ft^2/yr\ (3 \times 10^{-6}\ cm^2/y$

$k = 0.025\ ft/yr\ (2.5 \times 10^{-8}\ cm/s$

$n = 30\%$

$X = 30\ ft.$



Note:
For $i \leq -0.5$
$C/C_o < .00001$
@ all times.

Full Logarithmic, 3 × 3 Cycles

```
run
Porosity: 0.3
Permeability(ft/yr): .025
Diffusion Coef(ft /yr): 0.102
Wall Thickness: 30
Hydraulic Gradient: -0.3
Time(yrs): 500
-------------------------------------------------------------------
1st Argument(Y1)is:                          2.9756
1st Error Function is:                       0.9999
2nd Argument(Y2)is:                          1.22525
2nd Error Function is:                       0.9173
Exit/Source Concentration Ratio  (C/Co)is:                    8E-05
-------------------------------------------------------------------
Continue Calculations (y/n) ? y


Time(yrs): 750
-------------------------------------------------------------------
1st Argument(Y1)is:                          2.78685
1st Error Function is:                       0.99979
2nd Argument(Y2)is:                          0.64312
2nd Error Function is:                       0.63658
Exit/Source Concentration Ratio  (C/Co)is:                    2.2E-04
-------------------------------------------------------------------
Continue Calculations (y/n) ? y


Time(yrs): 1000
-------------------------------------------------------------------
1st Argument(Y1)is:                          2.72291
1st Error Function is:                       0.99973
2nd Argument(Y2)is:                          0.24754
2nd Error Function is:                       0.27399
Exit/Source Concentration Ratio  (C/Co)is:                    3.7E-04
-------------------------------------------------------------------
Continue Calculations (y/n) ? y


Time(yrs): 2000
-------------------------------------------------------------------
1st Argument(Y1)is:                          2.80056
1st Error Function is:                       0.9998
2nd Argument(Y2)is:                          -0.70014
2nd Error Function is:                       0
Exit/Source Concentration Ratio  (C/Co)is:                    4.2E-04
-------------------------------------------------------------------
Continue Calculations (y/n) ? y


Time(yrs): 5000
-------------------------------------------------------------------
1st Argument(Y1)is:                          3.43176
1st Error Function is:                       0.99998
2nd Argument(Y2)is:                          -2.10334
2nd Error Function is:                       0
Exit/Source Concentration Ratio  (C/Co)is:                    3.3E-04
-------------------------------------------------------------------
Continue Calculations (y/n) ? n
```

1704 Morton Street
Ann Arbor, MI 48104

16 February 1984

INING PROP.
22 FEB 84 8:20

Mr. David S. Miller
Mining Properties Department
Rouge Steel Company
3001 Miller Road
Dearborn, MI 48121

RE: Allen Park Clay Mine/Landfill

Dear Dave:

I have reviewed the memorandum dated January 23, 1984, from Terry McNiel, Technical Services Section, to Larry Aubuchon, Compliance Section, Detroit District, MDNR. The memorandum essentially raises the following objections to the findings and conclusions in my report, viz.,

Objection 1. There is no substantiation nor literature citations to show that organics present in the waste will not increase permeability.

Objection 2. The presence and possible effects of napthalene in the waste are disregarded.

Objection 3. Uncertainties remain about the actual composition and likely nature of the leachate.

Objection 4. The report does not address the question of compatibility between the following:
    a) Leachate and leachate collection system components
    b) Generated gases and clay cap.

In the opinion of the MDNR reviewer Objections 1,2,and 3 taken together mean that Specific Condition 5.A.4 (a) of Act 64 license is not satisfied. The reviewer goes on to say, however, that they (MDNR) would accept compatibility testing between actual leachate being generated and the on-site clay being used for containment. I will respond herein to these stated objections and opinion. Objection 4 which pertains to Specific Condition 5.A.4 (b) and (c) is outside the scope and original charge of my investigation.

Objection 1 is a version of the "guilty until proved innocent" syndrome. I understand and even sympathize with this approach in matters which deal with the release of potentially hazardous substances into the environment. There is, however, considerable substantiation in the published technical literature for the contention that organics present in low concentrations in aequous leachate will not increase the permeability of dense clays.

Leachate permeability tests on sand-clay columns packed to bulk densities within the range of densities of natural clays (Cartwright et al., 1977) have shown that permeability actually decreased with passage of leachate (containing organics). These tests were continued for periods up to nine months. Decreases were even more pronounced for raw, unsterilized leachate. In addition to permeability reduction from the passage of leachate, Griffin and Shimp (1976) have shown that heavy metal ions (Pb, Zn, Cd, Hg) are strongly attenuated by clay. Organics that were present in the leachate were only moderately attenuated by the clay; they did not increase hydraulic conductivity. We have also conducted long term leachate permeability tests ourselves on a silty clay almost identical in composition to the clay underlying the Allen Park Clay Mine/Landfill site (Gray, 1982) and found the same results, i.e., no increase in permeability was observed. A chemical analysis of the leachates used in all these permeability tests is attached. Note the presence of napthalene in one of the leachates--a constituent whose presence and influence the MDNR reviewer claimed we had not considered. [Note: Cited references are listed in an attachment to this letter report.]

It is important to emphasize again the fact that leachate permeability tests conducted by Anderson (1982) are totaly unrepresentative of conditions at the Allen Park site. These tests are often cited as an example of the deleterious influence of organic solvents on clay liner permeability. Anderson's tests are unrepresentative and irrelevant for the following reasons:

1. He used pure organic solvents. The leachate at the Allen Park Clay Mine/Landfill will be an aequous extract containing very low concentrations of organics.

2. He forced the solvents through clays at extremely high, positive gradients. Anderson used positive gradients ranging from 60 to 300. At the Allen Park site there will be negative (reverse) gradients ranging on the order of -0.3 (worst case) to -2.7.

Other objections can also be cited in regard to Anderson's test procedures and results. He used a rigid wall permeameter which permits channeling between sample and container. The recommended procedure to avoid this potential problem is to use a flexible, pressurized jacket. Large reported increases in permeability should be viewed with some skepticism when rigid wall permeameters have been employed.

Green et al. (1981) have investigated in great detail the charateristics of organic solvents that affect their rate of movement (permeability) in compacted clay. They measured the equilibrium permeability of three clays (a clay shale, a fire clay, and kaolinite) to the following solvents: benzene, xylene, carbon tetrachloride, trichloroethylene, acetone, methanol, glycerol, and water. Their study showed that it is the hydrophilic or hydrophobic nature of the solvent (as measured by the octanol/water partitioning coefficient or roughly by the dielectric constant) and not the viscosity/density ratio that is important in predicting a solvents rate of flow through clays. According to their findings water, which has a high dielectric constant, always exhibited the highest permeability. In addition, they found that the packed clay density is crucial in determining how permeable a clay will be to a given solvent. At high bulk densities (on the order of 115 pcf or 1.85 g/cc) the solvent characteristics became less important in differentiating permeability response.

Green _et_ _al_. (1981) also observed that solvents of low dielectric constant (e.g. xylene and carbon tetrachloride) tended to cause shrinkage and cracking of some of the clays. This phenomenon, known as syneresis, can and eventually did cause an apparent permeability increase in some of the clays that were tested. The same phenomenon was reported by Anderson(1982) in some of his experiments. It must be emphasized again, however, that the effect has only been observed and reported when several pore volumes of _pure_, _low-dielectric_ organic solvents are forced at _very_ _high_ _gradients_ through clay columns. These conditions simply do not occur at the Allen Park Clay Mine/Landfill site.

On the contrary, the conditions at the Allen Park site are ideal for effective containment, viz.,

1. The site is underlain by a thick ($X \geq 25$ ft) section of dense, competent silty clay (γ_D = 115 pcf) with a very low hydraulic conductivity ($k = 2 \times 10^{-8}$ cm/sec)

2. A negative hydraulic gradient exists at the site as result of artesian conditions in the underlying aquifer. Even under worst case assumptions (viz., leachate levels rising to the top of the landfill) a negative gradient of -0.3 will still be present.

3. The leachate consists of very low concentrations of organic and inorganic solutes in an aqueous solution as opposed to a pure solvent.

Under these conditions advective transport or hydraulic seepage ceases to dominate pollutant movement across a clay barrier (see Gilbert and Cherry, 1983; Tallard, 1984). Instead, diffusion under chemical concentration gradients becomes more important, and it is this transport mechanism that must be evaluated carefully. I have dealt with this problem both in my original report and in my subsequent letter report to Mr. Mark Young, Wayne Disposal, Inc., dated 25 September 1983. I showed that even under worst case assumptions of no partitioning or attenuation of pollutants and minimum, negative hydraulic gradients breakthrought times would be on the order of thousands of years. Interestingly, if the calculations are repeated allowing the hydraulic conductivity or permeability to double or even triple, the breakthrough time increase even more because now the counter advective flow is more effective in opposing the downward diffusion of solutes along their concentration gradient.

I come now to the MDNR comments about requiring compatibility testing (whatever that means) between actual leachate and the clay liner material. Unfortunately, the procedure, rationale, etc. for such tests are not specified. What is being required ...that the leachate be forced under high hydraulic gradients through a thin sample of the silty clay? The results or significance of such a test would be ambiguous at best and meaningless at worst in this case. In my opinion, such tests would be an exercise in futility and irrelevance given the condition and circumstances at the Allen Park Clay Mine/Landfill site.

Breakthrough times in diffusion controlled transport are extremely sensitive to thickness of the barrier. In order to replicate conditions in the field at Allen Park, compatibility or flow tests should be run on a sample column 25 feet high under a negative gradient no less than -0.3. After a wait time of thousands of years such a test would merely confirm what is already demonstrable.

It is my professional opinion that in this instance the requirement for compatibility testing and concern over permeability is a diversion from the real issue which is the likelihood of diffusion transport of solute across the clay. I have shown that this will not be a problem at the Allen Park Clay Mine/Landfill site because of the thickness, competency, and density of the underlying clay together with the existence of a negative gradient.

I find it baffling that MDNR can approve a thin, clay slurry wall for a toxic waste site (see Consent Judgment, U.S. District Court, U.S. Envl. Protection Agency and The State of Michigan, Plaintiffs, vs. Velsicol Chemical Corp., Defendant) based on meagre and inadequate evaluation whilst insisting on irrelevant tests for a thick, natural clay containment system at Allen Park that is ideal in nearly every respect.

Sincerely,

Donald H. Gray

Donald H. Gray
Professor of Civil Engineering

Attachments

ATTACHMENT NO. 1 - CITED REFERENCES

Anderson, D. (1982). Does landfill leachate make clay liners more permeable? Civil Engineering, ASCE, Vol. 52, pp. 66-69

Cartwright, K., Griffin, R.A., and Gilkeson, R.H. Migration of landfill leachate through glacial tills, Groundwater, Vol. 15, No. 4, pp. 294-305

Gilham, R.W. and Cherry, J.A. (1983). Predictability of solute transport in diffusion-controlled hydrogeologic regimes, Proceedings, Symposium on Low-Level Waste Disposal, U.S. NRC, NUREG/CP-0028, Conf-820911, Vol. 3, pp. 379-410

Gray, D.H. (1982). Influence of leachate on clay liner permeability, Wayne Disposal landfill site, Report prepared for Wayne Disposal, Inc., September 1982

Green, W.J., Lee, F.G., and Jones, R.A. (1981). Clay-soils permeability and hazardous waste storage, Journal of WPCF, Vol. 53, No. 8, pp. 1347-1354

Griffin, R.A. and Shimp, N.F. (1976). Attenuation of pollutants in municipal landfill leachate by clay minerals, Cincinnati Ohio: Final Report for U.S. Envl Protection Agency, Contract 68-03-0211

Tallard, G. (1984). Slurry trenches for containing hazardous wastes, Civil Engineering, ASCE, Vol. 54, No. 2, pp. 41-45

ATTACHMENT NO 2

Table 2. Chemical Analysis of Landfill Leachates

Analysis	DuPage County Landfill-mg/l	Wayne Disposal Landfill-mg/l
Na	748	3400
K	501	-
Ca	47	46
Mg	233	370
Cu	<0.1	0.55
Zn	18.8	5.0
Pb	4.46	0.91
Cd	1.95	0.10
Ni	0.3	0.40
Hg	0.0008	0.010
Cr	<0.1	0.31
Fe	4.2	7.77
Mn	<0.1	-
Al	<0.1	-
NH_4	862	1540
As	0.11	0.0044
B	29.9	<0.005
Si	14.9	-
Cl	3484	5800
SO_4	<0.1	200
NO3	-	<0.1
HCO_3	-	6920
COD	1340	2160
TOC	-	2500
TSS	-	512
pH	6.9	7.6
Spec. Cond. (mmhos/cm)	10.2	28.0
Equiv. TDS	6528	17,920
Organics:		
organic acids (phenol)	0.3	3.6
toluene	-	0.45
napthalene	-	0.44
chlorobenzene	-	0.008

EXHIBIT E

L. M. MILLER & ASSOCI ES
CONSULTING ENGINEERS & GEOLOGISTS

2500 PACKARD RD., SUITE #106
ANN ARBOR, MICHIGAN 48104

June 17, 1982

Rouge Steel Company
Division of Mining Properties
3001 Miller Road
P.O. Box 1699
Dearbor, Mi 48121

Attention: Mr. David Miller

Re: Allen Park Clay Mine Seismic Survey

Dear Mr. Miller:

As per your request a seismic study was performed at the Allen Park Clay Mine area in Allen Park, Michigan. The purpose of this study was an attempt to determine the depth to bedrock in the area immediately below the excavated pit at the disposal area.

Keeping consistent with previous seismic work accomplished in the area these stations were numbered 4, 5 and 6. Stations 4 and 5 were completed on the excavated pit floor, 4 being on the eastern half and 5 on the western side of the pit floor, with station 6 directly to the north of the pit up on approximately the existing surface elevation, some 30 to 40 feet above the pit floor. Plots of the data collected are included and indicate both the velocities of the layers and the depths to the layer interfaces.

Station 4 resulted in the best data collected at the site, and shows a three-layer case. A low velocity (1428 ft/sec) layer is underlain by a very consistent layer with a velocity of 5233 ft/sec, extending to a depth of 57 feet below the pit floor where it is underlain by a much higher velocity (12,808 ft/sec) layer. These values are very typical of a dense clay layer underlain by a hard limestone type material. The rather good fit of the data to a line would indicate very consistent materials, however, the irregularities near the 57 foot contact indicate that this interface is not as sharp a transition and hence it represents more of a minimum depth to this interface.

At Station 5 area surface topography was rough and inconsistent which resulted in limited data being collected. In one area a very steep depression was encountered on the surface which the shock wave source worked in. This abrupt lowering of the elevation causes a decrease in the time it takes to the shock wave to travel through the subsurface. Therefore, the best fit line was drawn through only those points where the shock wave source was at the approximate same elevation. Had the elevation been consistent, the travel times for those distances, which were lower, would have been increased in the direction towards this line.

Station 5 showed approximately the same subsurface conditions as did 4, with a depth to the bedrock being indicated at 70 feet below the pit floor. Station 6 was run at a much higher elevation than that of the pit floor, and very soft wet surface conditions were found. These types of surface conditions do not allow for seismic shock waves to propogate as the material tends to absorb much of the energy and transmit this energy directly across the surface rather than down into the earth. This data indicates again a rather consistent layer with a velocity typical of a dense clay. As a rule of thumb, seismic tests measure in depth roughly one-third the distance from the energy source to the geophone. Using this rule the limits of our data would be to a depth of approximately 45 feet for the clay layer and would obviously extend until the next layer is encountered.

We hope that this information is useful to you. If any further information on subsurface conditions is needed, it should be noted that there is enough room in the bottom of the excavated pit for an electrical resistivity test to be run. The problems caused by surface conditions could be avoided and with the large contrast in the subsurface materials this test would most likely work well.

If we can be of any further assistance, please let us know.

Very truly yours,

L. M. MILLER & ASSOCIATES

Timothy Wilson

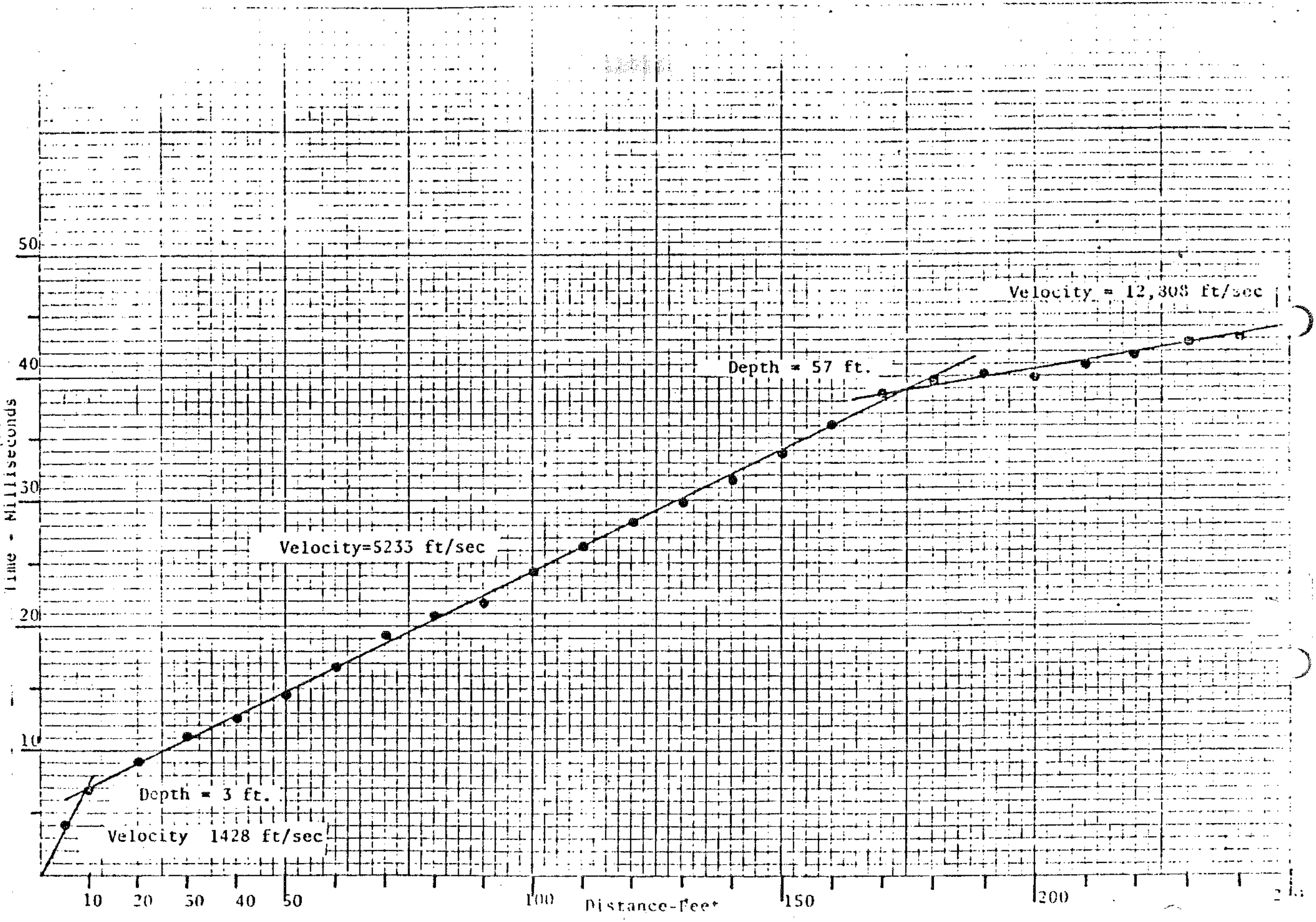
Timothy P. Wilson, Geologist

TPW:hrh

Attachments as mentioned above.

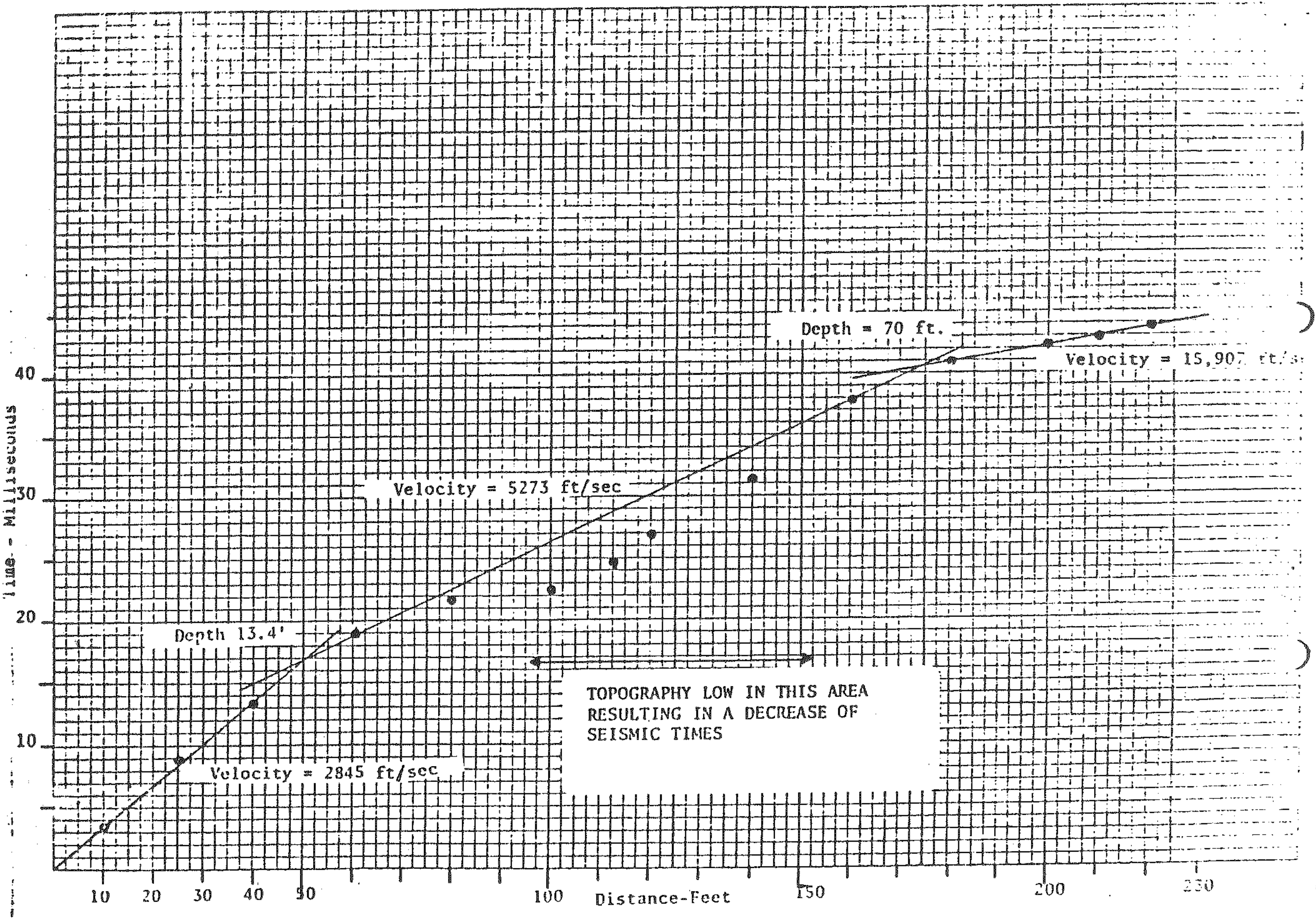
ALLEN PARK CLAY MINE
SEISMIC STATION #4

L. M. MILLER & ASSOCIATES



ALLEN PARK CLAY MINE
SEISMIC STATION #5

L. M. MILLER & ASSOCIAT



SEISMIC STATION #6

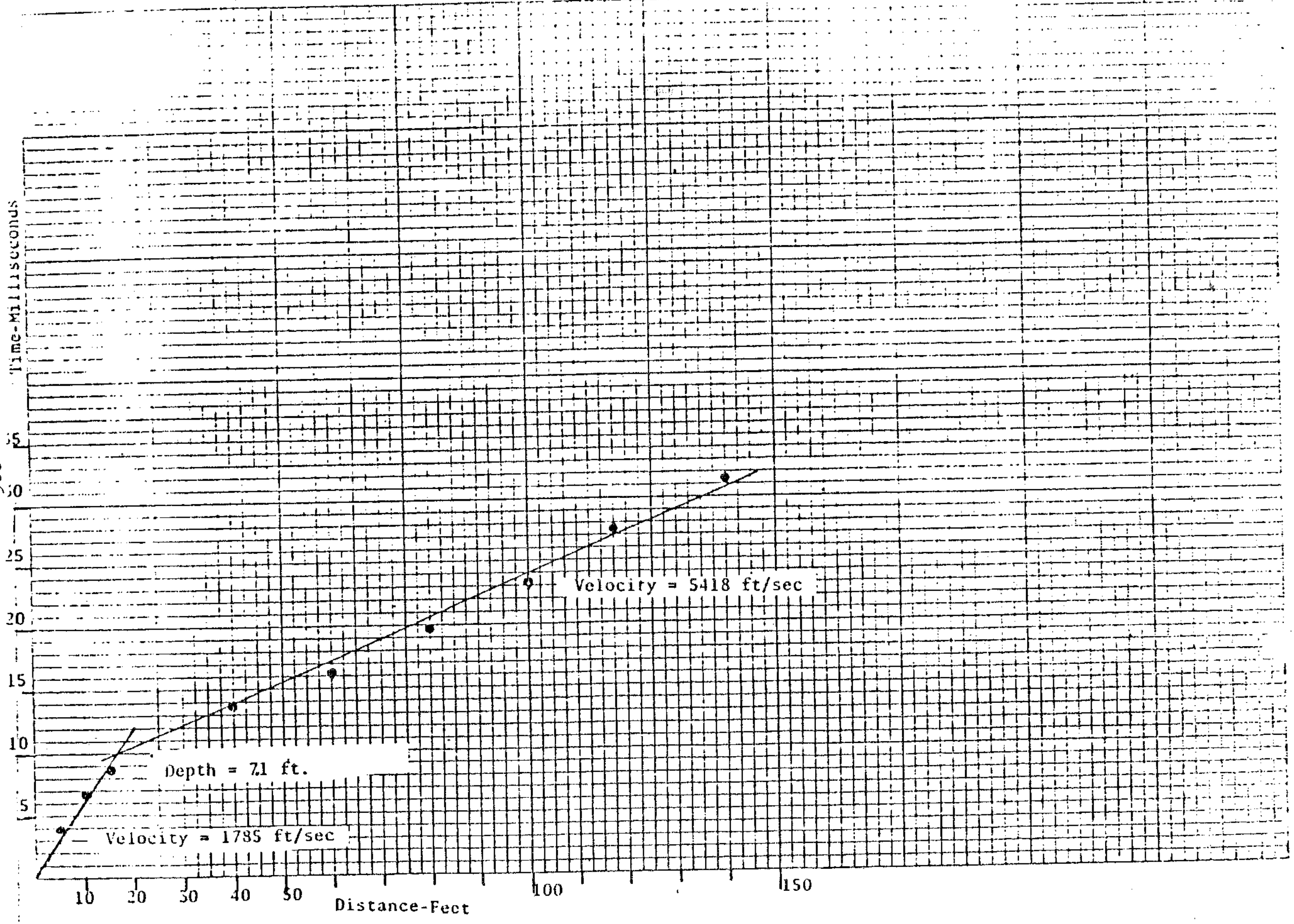


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EXHIBIT G

RESOURCE RECOVERY COMMISSION
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ADMINISTRATION/RESOURCE RECOVERY SECTION
517/373-0540

PLANNING SECTION/HAZARDOUS WASTE SECTION
517/373-1818

GEOLOGY SECTION
517/373-0907

November 4, 1981

Mr. Marshall Austin
Michigan Testing Engineers, Inc.
24355 Capitol Avenue
Detroit, Michigan 48239

RE: Permeability testing of clay soils
Allen Park Clay Mine; Allen Park, Michigan
Wayne County

Dear Marshall:

Based on the review of the soil tests performed (grain size analysis, atterberg limits and permeability) on the clay at the Allen Park Clay Mine Landfill, it is the feeling of this office that the materials are uniform enough that no further permeability testing will be required. This portion of our evaluation has been satisfied with the information submitted.

If you have any questions, please feel free to call.

Very truly yours,

RESOURCE RECOVERY DIVISION

James Janiczek
Geologist

JJ:nm

cc: Shakir/Belobraidich
Mark Young, Wayne Disposal
Wayne County Health Department

E-2 Interim Status Groundwater Monitoring Data

40 CFR 270.14(c)(1),
40 CFR 265.90
40 CFR 265.94

During the facility's initial year of Interim Status (November 1980 - November 1981), a hydrogeological study was performed on the site which included the installation of five monitor wells in satisfaction of Federal and State regulations. Quarterly samples were then taken to provide initial background data, while at the same time additional information was being obtained to demonstrate that there is no potential for migration of liquid from the regulated unit to the uppermost aquifer during the active life of the unit.

Groundwater monitoring data obtained during Interim Status is provided in Attachment 16. The data is grouped as follows:

. EPA Primary Interim Status Drinking Water Standards Appendix III	page 212
. Contamination Indicating Parameters	page 221
. Additional Water Quality Parameters	page 226

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 2-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	600.67
Arsenic	mg/l	<0.0003
Barium	mg/l	<0.100
Cadmium	mg/l	0.240
Chromium	mg/l	<0.010
Fluoride	mg/l	0.940
Lead	mg/l	<0.050
Mercury	mg/l	<0.0002
Nitrate	mg/l	<0.100
Selenium	mg/l	<0.0003
Silver	mg/l	<0.010
Endrin	ug/l	<0.0002
Lindane	ug/l	<0.004
Methoxychlor	ug/l	<0.010
Toxaphene	ug/l	<0.005
2,4-D	ug/l	<0.100
2,4,5-TP/Silvex	ug/l	<0.001
Radium	pCi/l	<5.00
Gross Alpha	pCi/l	<5.00
Gross Beta	pCi/l	<5.00
Coliform Bact.	co/100ml	2.00
Chloride	mg/l	150.
Iron	mg/l	<0.030
Manganese	mg/l	<0.010
Phenols	mg/l	0.008
Sodium	mg/l	110.
Sulfate	mg/l	1050.

Time of Execution: 06/18/84 1510.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 2-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	11-26-82
Static	Feet	599.81	600.68	600.66
Arsenic	mg/l	<0.010	<0.001	<0.001
Barium	mg/l	<0.040	<0.020	<0.100
Cadmium	mg/l	0.623	0.006	<0.003
Chromium	mg/l	0.050	0.011	0.016
Fluoride	mg/l	0.800	0.800	0.900
Lead	mg/l	0.093	0.030	<0.010
Mercury	mg/l	<0.0002	<0.0002	<0.0002
Nitrate	mg/l	<0.010	0.010	<0.010
Selenium	mg/l	<0.010	<0.010	<0.010
Silver	mg/l	0.010	0.004	0.008
Endrin	ug/l	<0.100	<0.100	<0.100
Lindane	ug/l	<0.100	<0.100	<0.100
Methoxychor	ug/l	<0.500	<0.500	<0.500
Toxaphene	ug/l	<1.00	<1.00	<1.00
2,4-D	ug/l	<0.100	<0.100	<0.100
2,4,5-TP/Silvex	ug/l	<0.050	<0.050	<0.050
Radium	pCi/l	<5.00	<5.00	<5.00
Gross Alpha	pCi/l	<5.00	<5.00	<5.00
Gross Beta	pCi/l	<4.00	<8.00	<8.00
Coliform Bact.	co/100ml	<2.00	<4.00	<2.20
Chloride	mg/l	170.	170.	170.
Iron	mg/l	5.10	0.840	0.450
Manganese	mg/l	0.130	0.023	0.024
Phenols	mg/l	0.004	<0.004	<0.004
Sodium	mg/l	120.	110.	240.
Sulfate	mg/l	890.	1000.	880.

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Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 5-D Up Gradient

	Date Sampled:	05-06-82	07-14-82	10-26-82
Parameter	Units			
Static	Feet	605.12	605.45	604.84
Arsenic	mg/l	<0.010	<0.001	<0.001
Barium	mg/l	0.060	<0.020	<0.050
Cadmium	mg/l	0.006	<0.003	<0.003
Chromium	mg/l	<0.005	0.016	0.019
Fluoride	mg/l	1.30	1.00	1.00
Lead	mg/l	0.010	<0.010	0.091
Mercury	mg/l	<0.0002	0.0005	<0.0002
Nitrate	mg/l	0.010	0.250	<0.010
Selenium	mg/l	<0.010	<0.010	<0.010
Silver	mg/l	0.003	<0.003	<0.005
Endrin	ug/l	<0.100	<0.100	<0.100
Lindane	ug/l	<0.100	<0.100	<0.100
Methoxychor	ug/l	<0.500	<0.500	<0.500
Toxaphene	ug/l	<1.00	<1.00	<1.00
2,4-D	ug/l	<0.100	<0.100	<0.100
2,4,5-TP/Silvex	ug/l	<0.050	<0.050	<0.050
Radium	pCi/l	<2.00	<5.00	<5.00
Gross Alpha	pCi/l	<5.00	<5.00	<5.00
Gross Beta	pCi/l	<4.00	<4.00	<8.00
Coliform Bact.	co/100ml	<2.00	<4.00	4.00
Chloride	mg/l	140.	150.	140.
Iron	mg/l	1.70	1.20	0.880
Manganese	mg/l	0.023	0.016	0.008
Phenols	mg/l	<0.004	<0.004	<0.004
Sodium	mg/l	85.0	88.0	180.
Sulfate	mg/l	190.	200.	70.0

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Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 102-D Down GraDient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	603.22
Arsenic	mg/l	<0.0003
Barium	mg/l	<0.100
Cadmium	mg/l	<0.010
Chromium	mg/l	<0.010
Fluoride	mg/l	1.42
Lead	mg/l	<0.050
Mercury	mg/l	<0.0002
Nitrate	mg/l	<0.100
Selenium	mg/l	<0.0003
Silver	mg/l	<0.010
Endrin	ug/l	<0.0002
Lindane	ug/l	<0.004
Methoxychor	ug/l	<0.010
Toxaphene	ug/l	<0.005
2,4-D	ug/l	<0.100
2,4,5-TP/Silvex	ug/l	<0.001
Radium	pCi/l	<5.00
Gross Alpha	pCi/l	<5.00
Gross Beta	pCi/l	<5.00
Coliform Bact.	co/100ml	4.00
Chloride	mg/l	130.
Iron	mg/l	<0.030
Manganese	mg/l	<0.010
Phenols	mg/l	<0.005
Sodium	mg/l	100.
Sulfate	mg/l	1200.

Time of Execution: 06/18/84 1510.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 102-D Down GraDient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	601.77	601.66	599.15
Arsenic	mg/l	<0.010	<0.001	<0.001
Barium	mg/l	<0.040	<0.020	<0.100
Cadmium	mg/l	0.008	<0.003	<0.003
Chromium	mg/l	<0.005	0.006	0.006
Fluoride	mg/l	1.30	1.00	1.00
Lead	mg/l	0.010	<0.010	0.010
Mercury	mg/l	<0.0002	<0.0002	<0.0002
Nitrate	mg/l	<0.010	0.270	<0.010
Selenium	mg/l	<0.010	<0.010	<0.010
Silver	mg/l	0.006	0.004	0.005
Endrin	ug/l	<0.100	<0.100	<0.100
Lindane	ug/l	<0.100	<0.100	<0.100
Methoxychor	ug/l	<0.050	<0.500	<0.500
Toxaphene	ug/l	<1.00	<1.00	<1.00
2,4-D	ug/l	<0.100	<0.100	<0.100
2,4,5-TP/Silvex	ug/l	0.050	<0.050	<0.050
Radium	pCi/l	<5.00	<5.00	<5.00
Gross Alpha	pCi/l	<5.00	<5.00	<5.00
Gross Beta	pCi/l	<8.00	<4.00	<6.00
Coliform Bact.	co/100ml	<2.00	<4.00	<2.20
Chloride	mg/l	140.	140.	140.
Iron	mg/l	0.530	5.10	1.20
Manganese	mg/l	0.023	0.041	0.016
Phenols	mg/l	<0.004	<0.004	<0.004
Sodium	mg/l	95.0	97.0	200.
Sulfate	mg/l	910.	960.	810.

Time of Execution: 06/18/84 1510.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 103-D Down Gradient

Date Sampled: 08-11-81

Parameter	Units	
Static	Feet	603.52
Arsenic	mg/l	<0.0003
Barium	mg/l	<0.100
Cadmium	mg/l	<0.010
Chromium	mg/l	<0.010
Fluoride	mg/l	1.31
Lead	mg/l	<0.050
Mercury	mg/l	<0.0002
Nitrate	mg/l	<0.100
Selenium	mg/l	<0.0003
Silver	mg/l	<0.010
Endrin	ug/l	<0.0002
Lindane	ug/l	<0.004
Methoxychor	ug/l	<0.010
Toxaphene	ug/l	<0.005
2,4-D	ug/l	<0.100
2,4,5-TP/Silvex	ug/l	<0.001
Radium	pCi/l	<5.00
Gross Alpha	pCi/l	<5.00
Gross Beta	pCi/l	<5.00
Coliform Bact.	co/100ml	<2.00
Chloride	mg/l	25.0
Iron	mg/l	<0.030
Manganese	mg/l	<0.010
Phenols	mg/l	<0.005
Sodium	mg/l	6.00
Sulfate	mg/l	46.0

Time of Execution: 06/18/84 1510.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 103-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	603.65	601.23	601.26
Arsenic	mg/l	<0.001	<0.001	<0.001
Barium	mg/l	<0.020	<0.020	<0.200
Cadmium	mg/l	0.007	0.008	<0.003
Chromium	mg/l	0.020	<0.004	<0.005
Fluoride	mg/l	1:50	1.00	1.00
Lead	mg/l	<0.010	<0.010	<0.010
Mercury	mg/l	<0.0002	<0.0002	<0.0002
Nitrate	mg/l	<0.010	0.050	<0.010
Selenium	mg/l	<0.010	<0.010	<0.010
Silver	mg/l	0.005	0.003	0.007
Endrin	ug/l	<0.100	<0.100	<0.100
Lindane	ug/l	<0.100	<0.100	<0.100
Methoxychor	ug/l	<0.500	<0.500	<0.500
Toxaphene	ug/l	<1.00	<1.00	<1.00
2,4-D	ug/l	<0.100	<0.100	<0.100
2,4,5-TP/Silvex	ug/l	<0.050	<0.050	<0.050
Radium	pCi/l	<2.00	<5.00	<5.00
Gross Alpha	pCi/l	<3.00	<5.00	<5.00
Gross Beta	pCi/l	<4.00	<4.00	<8.00
Coliform Bact.	co/100ml	<2.00	<4.00	5.10
Chloride	mg/l	130.	140.	130.
Iron	mg/l	1.00	0.900	6.00
Manganese	mg/l	0.023	0.018	0.037
Phenols	mg/l	<0.004	0.006	<0.004
Sodium	mg/l	8.70	85.0	160.
Sulfate	mg/l	760.	790.	840.

Time of Execution: 06/18/84 1510.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 104-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	603.81
Arsenic	mg/l	<0.0003
Barium	mg/l	<0.100
Cadmium	mg/l	<0.010
Chromium	mg/l	<0.010
Fluoride	mg/l	1.31
Lead	mg/l	<0.050
Mercury	mg/l	<0.0002
Nitrate	mg/l	<0.100
Selenium	mg/l	<0.0003
Silver	mg/l	<0.010
Endrin	ug/l	<0.0002
Lindane	ug/l	<0.004
Methoxychor	ug/l	<0.010
Toxaphene	ug/l	<0.005
2,4-D	ug/l	<0.100
2,4,5-TP/Silvex	ug/l	<0.001
Radium	pCi/l	<5.00
Gross Alpha	pCi/l	<5.00
Gross Beta	pCi/l	<5.00
Coliform Bact.	co/100ml	4.00
Chloride	mg/l	140.
Iron	mg/l	<0.030
Manganese	mg/l	0.060
Phenols	mg/l	<0.005
Sodium	mg/l	100.
Sulfate	mg/l	1350.

Time of Execution: 06/18/84 15:0.0 edt Mon

Allen Park Clay Mine

Ground Water Monitoring Data

Drinking Water and Water Quality Parameters

Well: 104-D Down Gradient

Parameter	Units	05-06-82	07-14-82	10-26-82
Static	Feet	604.32	604.32	604.12
Arsenic	mg/l	<0.001	<0.010	<0.001
Barium	mg/l	<0.040	<0.020	<0.100
Cadmium	mg/l	0.010	<0.003	<0.003
Chromium	mg/l	<0.005	0.012	0.013
Fluoride	mg/l	1.00	0.900	1.00
Lead	mg/l	<0.010	<0.010	0.020
Mercury	mg/l	<0.0002	<0.002	<0.0002
Nitrate	mg/l	<0.010	0.230	0.250
Selenium	mg/l	<0.010	0.010	<0.010
Silver	mg/l	0.009	0.004	0.012
Endrin	ug/l	<0.100	<0.100	<0.100
Lindane	ug/l	<0.100	<0.100	<0.100
Methoxychor	ug/l	<0.500	<0.500	<0.500
Toxaphene	ug/l	<1.00	<1.00	<1.00
2,4-D	ug/l	<0.100	<0.100	<0.100
2,4,5-TP/Silvex	ug/l	<0.050	<0.050	<0.050
Radium	pCi/l	<5.00	<5.00	<5.00
Gross Alpha	pCi/l	<3.00	<3.00	<5.00
Gross Beta	pCi/l	<4.00	<4.00	11.0
Coliform Bact.	co/100ml	<2.00	8.00	9.20
Chloride	mg/l	150.	160.	140.
Iron	mg/l	4.30	9.90	52.0
Manganese	mg/l	0.060	0.042	0.100
Phenols	mg/l	<0.004	<0.004	<0.004
Sodium	mg/l	100.	88.0	210.
Sulfate	mg/l	1200.	1300.	1200.

Time of Execution: 06/18/84 1510.0 edt Mon

Table 2

Allen Park Clay Mine

Ground Water Monitoring Data

Contamination Indicating Parameters

Well: 2-D Down Gradient

* * Well Background Sampling Data * *

Parameter	Units	08-10-81	05-06-82	07-14-82	10-26-82
Static	Feet	600.67	599.01	600.68	600.68
pH1		7.70	6.91	7.75	8.70
pH2		7.90	6.95	7.76	8.70
pH3		8.00	7.01	7.73	8.70
pH4		8.00	7.09	7.76	8.70
Number of Samples		4	4	4	4
Mean Value		7.90	6.99	7.75	8.70
Variance		2.00E-02	6.13E-03	2.00E-04	0.00E+00
Sp.Cond1	umhos/cm	2500.	2295.	3054.	2256.
Sp.Cond2	umhos/cm	2200.	2085.	2983.	2244.
Sp.Cond3	umhos/cm	2400.	2187.	2980.	2252.
Sp.Cond4	umhos/cm	2200.	2127.	2875.	2250.
Number of Samples		4	4	4	4
Mean Value		2325.0	2173.5	2973.0	2250.5
Variance		2.25E+04	8.31E+03	5.44E+03	2.50E+01
TOC1	mg/l	7.70	20.0	3.00	15.0
TOC2	mg/l	7.00	20.0	5.00	20.0
TOC3	mg/l	7.70	19.0	5.00	17.0
TOC4	mg/l	7.60	19.0	5.00	16.0
Number of Samples		4	4	4	4
Mean Value		7.50	19.50	4.50	17.00
Variance		1.13E-01	3.33E-01	1.00E+00	4.67E+00
TOX1	mg/l	<0.005	0.012	0.029	0.010
TOX2	mg/l	<0.005	0.016	0.033	0.017
TOX3	mg/l	<0.005	0.015	0.046	0.026
TOX4	mg/l	<0.005	0.014	0.027	0.038
Number of Samples		4	4	4	4
Mean Value		0.005	0.014	0.034	0.023
Variance		0.00E+00	2.92E-06	7.29E-05	1.46E-04

Summary of Background Data

Parameter	Mean Value	Variance	Number of Samples
pH:	7.84	3.98E-01	16
Sp.Cond:	2430.5	1.15E+05	16
TOC:	12.13	4.33E+01	16
TOX:	0.019	1.64E-04	16

Time of Execution: 02/23/83 0730.2 est Wed

Table 2 (Cont.)

Allen Park Clay Mine

Ground Water Monitoring Data

Contamination Indicating Parameters

Well: 102-D Down GraDient

		* * Well Background Sampling Data * *			
Date Sampled:		08-10-81	05-06-82	07-14-82	10-26-82
Parameter	**Units**				
Static	Feet	603.22	601.77	601.68	599.15
pH1		8.40	7.30	7.20	8.70
pH2			7.30	7.20	8.70
pH3			7.30	7.20	8.70
pH4			7.30	7.30	8.70
Number of Samples		1	4	4	4
Mean Value		8.40	7.30	7.22	8.70
Variance		0.00E+00	6.36E-07	2.50E-03	0.00E+00
Sp.Cond1	umhos/cm	2500.	2993.	2524.	2392.
Sp.Cond2	umhos/cm		2997.	2664.	2398.
Sp.Cond3	umhos/cm		2973.	2651.	2358.
Sp.Cond4	umhos/cm		2940.	2630.	2378.
Number of Samples		1	4	4	4
Mean Value		2500.0	2975.8	2617.3	2381.5
Variance		0.00E+00	6.78E+02	4.06E+03	3.16E+02
TOC1	mg/l	5.60	9.00	21.0	16.0
TOC2	mg/l		12.0	15.0	24.0
TOC3	mg/l		11.0	17.0	23.0
TOC4	mg/l		13.0	19.0	16.0
Number of Samples		1	4	4	4
Mean Value		5.60	11.25	18.00	19.75
Variance		0.00E+00	2.92E+00	6.67E+00	1.89E+01
TOX1	mg/l	0.008	0.011	0.035	0.015
TOX2	mg/l		0.006	0.010	<0.010
TOX3	mg/l		0.006	0.010	0.016
TOX4	mg/l		0.007	0.010	0.013
Number of Samples		1	4	4	4
Mean Value		0.008	0.008	0.016	0.014
Variance		0.00E+00	5.67E-06	1.56E-04	7.00E-06

Summary of Background Data

Parameter	Mean Value	Variance	Number of Samples
pH:	7.79	4.94E-01	13
Sp.Cond:	2646.0	6.29E+04	13
TOC:	15.51	2.94E+01	13
TOX:	0.012	5.71E-05	13

Time of Execution: 02/23/83 0730.2 est Wed

Table 2 (Cont.)

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                     Allen Park Clay Mine

                 Ground Water Monitoring Data

             Contamination Indicating Parameters

                 Well:  103-D  Down Gradient

                  * *  Well Background Sampling Data   * *
                  ----------------------------------------

     Date  Sampled:  08-10-81  05-06-82  07-14-82  10-26-82
     --------------

Parameter  Units
---------  -----

 Static    Feet        603.52    603.65    601.23    601.26

 pH1                     8.60      7.02      7.70      8.70
 pH2                               7.09      7.70      8.70
 pH3                               7.11      7.70      8.70
 pH4                               7.12      7.70      8.70
 Number of Samples          1         4         4         4
 Mean Value              8.60      7.09      7.70      8.70
 Variance            0.00E+00  2.03E-03  0.00E+00  0.00E+00

 Sp.Cond1  umhos/cm      300.     2622.     2441.     2352.
 Sp.Cond2  umhos/cm               2604.     2468.     2308.
 Sp.Cond3  umhos/cm               2583.     2450.     2294.
 Sp.Cond4  umhos/cm               2616.     2438.     2288.
 Number of Samples          1         4         4         4
 Mean Value             300.0    2606.3    2449.3    2310.5
 Variance            0.00E+00  2.96E+02  1.82E+02  8.36E+02

 TOC1      mg/1          5.60      4.00      12.0      26.0
 TOC2      mg/1                    5.00      14.0      21.0
 TOC3      mg/1                    6.00      14.0      22.0
 TOC4      mg/1                    6.00      9.00      21.0
 Number of Samples          1         4         4         4
 Mean Value              5.60      5.25     12.25     22.50
 Variance            0.00E+00  9.17E-01  5.58E+00  5.67E+00

 TOX1      mg/1         0.029    <0.005     0.010     0.010
 TOX2      mg/1                  <0.005     0.054     0.010
 TOX3      mg/1                  <0.005     0.010     0.014
 TOX4      mg/1                  <0.005     0.010    <0.010
 Number of Samples          1         4         4         4
 Mean Value             0.029     0.005     0.021     0.011
 Variance            0.00E+00  0.00E+00  4.84E-04  4.00E-06

                  Summary of Background Data

         Parameter  Mean Value   Variance   Number of Samples
         ---------  ----------   --------   -----------------

               pH:        7.89   4.89E-01           13

         Sp.Cond:       2289.5   3.72E+05           13

              TOC:       12.74   5.76E+01           13

              TOX:       0.014   1.87E-04           13


 Time of Execution:  02/23/83  0749.7 est Wed
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Table 2 (Cont.)

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                  Allen Park Clay Mine

              Ground Water Monitoring Data

           Contamination Indicating Parameters

                Well:  104-D  Down Gradient

                    * *  Well Background Sampling Data    * *
                    ----------------------------------------

     Date  Sampled:  08-10-81  05-06-82  07-14-82  10-26-82
     --------------

Parameter  Units
---------  -----

 Static     Feet          603.81     604.32     604.32     604.12

 pH1                        8.00       6.89       7.70       8.30
 pH2                                   6.90       7.68       8.20
 pH3                                   6.91       7.68       8.20
 pH4                                   6.90       7.67       8.20
 Number of Samples             1          4          4          4
 Mean Value                 8.00       6.90       7.68       8.23
 Variance               0.00E+00   6.61E-05   1.58E-04   2.50E-03

 Sp.Cond1  umhos/cm        2550.      1980.      2817.      2898.
 Sp.Cond2  umhos/cm                   1960.      2885.      2862.
 Sp.Cond3  umhos/cm                   1980.      2885.      2838.
 Sp.Cond4  umhos/cm                   1920.      2852.      2871.
 Number of Samples             1          4          4          4
 Mean Value               2550.0     1960.0     2859.8     2867.3
 Variance               0.00E+00   8.00E+02   1.05E+03   6.14E+02

 TOC1       mg/l            6.60       7.00       6.00       11.0
 TOC2       mg/l                       10.0       12.0       15.0
 TOC3       mg/l                       8.00       14.0       10.0
 TOC4       mg/l                       8.00       12.0       12.0
 Number of Samples             1          4          4          4
 Mean Value                 6.60       8.25      11.00      12.00
 Variance               0.00E+00   1.58E+00   1.20E+01   4.67E+00

 TOX1       mg/l          <0.005     <0.005      0.010      0.024
 TOX2       mg/l                     <0.005      0.024      0.018
 TOX3       mg/l                     <0.005      0.010      0.010
 TOX4       mg/l                     <0.005      0.048      0.020
 Number of Samples             1          4          4          4
 Mean Value                0.005      0.005      0.023      0.018
 Variance               0.00E+00   0.00E+00   3.21E-04   3.47E-05

                    Summary of Background Data

          Parameter  Mean Value  Variance   Number of Samples
          ---------  ----------  --------   -----------------

                pH:      7.63    3.09E-01         13

          Sp.Cond:     2561.4    1.82E+05         13

               TOC:     10.12    8.20E+00         13

               TOX:     0.015    1.55E-04         13


   Time of Execution:  02/23/83  0730.2 est Wed
```

Table 2 (Cont.)

Allen Park Clay Mine

Ground Water Monitoring Data

Contamination Indicating Parameters

Well: 5-D Up Gradient

** Well Background Sampling Data **

Parameter	Units	Date Sampled: 08-10-81	05-06-82	07-14-82	10-26-82
Static	Feet	605.09	605.12	605.45	604.84
pH1		9.60	7.32	7.44	10.2
pH2			7.28	7.50	10.2
pH3			7.31	7.67	10.2
pH4			7.32	7.60	10.2
Number of Samples		1	4	4	4
Mean Value		9.60	7.31	7.55	10.20
Variance		0.00E+00	3.58E-04	1.05E-02	0.00E+00
Sp.Cond1	umhos/cm	1550.	2160.	1990.	1785.
Sp.Cond2	umhos/cm		2109.	1918.	1800.
Sp.Cond3	umhos/cm		2121.	1939.	1791.
Sp.Cond4	umhos/cm		2100.	1954.	1860.
Number of Samples		1	4	4	4
Mean Value		1550.0	2122.5	1950.3	1809.0
Variance		0.00E+00	6.99E+02	9.20E+02	1.19E+03
TOC1	mg/l	9.00	6.00	21.0	21.0
TOC2	mg/l		5.00	18.0	20.0
TOC3	mg/l		5.00	18.0	9.00
TOC4	mg/l		6.00	20.0	33.0
Number of Samples		1	4	4	4
Mean Value		9.00	5.50	19.25	20.75
Variance		0.00E+00	3.33E-01	2.25E+00	9.63E+01
TOX1	mg/l		0.006	0.064	0.021
TOX2	mg/l		0.010	0.032	0.041
TOX3	mg/l		0.009	0.024	0.025
TOX4	mg/l		0.008	0.026	0.032
Number of Samples		0	4	4	4
Mean Value			0.008	0.037	0.030
Variance			2.92E-06	3.48E-04	7.69E-05

Summary of Background Data

Parameter	Mean Value	Variance	Number of Samples
pH:	8.45	1.84E+00	13
Sp.Cond:	1929.0	3.01E+04	13
TOC:	14.69	7.47E+01	13
TOX:	0.025	2.75E-04	12

Attachment 16

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 2-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	600.67
COD	mg/l	2.60
Iron	mg/l	<0.030
Chloride	mg/l	150.
Sulfate	mg/l	1050.
Sp. Conductance	umhos/cm	2500.
Sp. Conductance	umhos/cm	2400.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
pH 1		7.70
pH 2		8.00
pH 3		7.90
pH 4		8.00
TOC 1	mg/l	7.70
TOC 2	mg/l	7.00
TOC 3	mg/l	7.70
TOC 4	mg/l	7.60
Calcium	mg/l	200.
Sodium	mg/l	110.
Magnesium	mg/l	160.
Bicarbonate	mg/l	200.
Ammonia-Nitrogen	mg/l	0.500
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	0.002
Phenols	mg/l	0.008
Chromium	mg/l	<0.010
Cadmium	mg/l	0.240
Lead	mg/l	<0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 2-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	599.01	600.68	600.68
COD	mg/l			
Iron	mg/l	5.10	0.840	0.450
Chloride	mg/l	150.	170.	170.
Sulfate	mg/l	1050.	1000.	860.
Sp. Conductance	umhos/cm	2295.	3054.	2256.
Sp. Conductance	umhos/cm	2085.	2983.	2244.
Sp. Conductance	umhos/cm	2187.	2980.	2252.
Sp. Conductance	umhos/cm	2127.	2875.	2250.
pH 1		6.91	7.75	8.70
pH 2		6.95	7.76	8.70
pH 3		7.01	7.73	8.70
pH 4		7.09	7.76	8.70
TOC 1	mg/l	20.0	3.00	15.0
TOC 2	mg/l	20.0	5.00	20.0
TOC 3	mg/l	19.0	5.00	17.0
TOC 4	mg/l	19.0	5.00	16.0
Calcium	mg/l			
Sodium	mg/l	120.	110.	240.
Magnesium	mg/l			
Bicarbonate	mg/l			
Ammonia-Nitrogen	mg/l			
Nitrogen-Nitrate	mg/l	<0.010	0.010	<0.010
Nitrogen-Nitrite	mg/l			
Phenols	mg/l	0.004	<0.004	<0.004
Chromium	mg/l	0.050	0.010	0.016
Cadmium	mg/l	0.023	0.006	<0.003
Lead	mg/l	0.093	0.030	<0.010
Napthalene	mg/l			

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 2-D Down Gradient

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet	600.74	600.67
COD	mg/l		110.
Iron	mg/l		2.20
Chloride	mg/l		190.
Sulfate	mg/l		1210.
Sp. Conductance	umhos/cm		2700.
Sp. Conductance	umhos/cm		2600.
Sp. Conductance	umhos/cm		2600.
Sp. Conductance	umhos/cm		2600.
pH 1			7.40
pH 2			7.40
pH 3			7.50
pH 4			7.60
TOC 1	mg/l		31.0
TOC 2	mg/l		14.0
TOC 3	mg/l		27.0
TOC 4	mg/l		32.0
Calcium	mg/l		340.
Sodium	mg/l		120.
Magnesium	mg/l		230.
Bicarbonate	mg/l		350.
Ammonia-Nitrogen	mg/l		1.10
Nitrogen-Nitrate	mg/l		0.040
Nitrogen-Nitrite	mg/l		<0.020
Phenols	mg/l		
Chromium	mg/l		<0.020
Cadmium	mg/l		
Lead	mg/l		0.440
Napthalene	mg/l		

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 2-D Down Gradient

Parameter	Units	Date Sampled 04-17-84
Static	Feet	586.97
COD	mg/l	110.
Iron	mg/l	3.30
Chloride	mg/l	170.
Sulfate	mg/l	2600.
Sp. Conductance	umhos/cm	2600.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.60
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	11.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	200.
Sodium	mg/l	110.
Magnesium	mg/l	150.
Bicarbonate	mg/l	320.
Ammonia-Nitrogen	mg/l	0.630
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Time of Execution: 06/15/84 0933.0 edt Fri

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 5-D Up Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	605.89
COD	mg/l	3.80
Iron	mg/l	<0.030
Chloride	mg/l	126.
Sulfate	mg/l	240.
Sp. Conductance	umhos/cm	1550.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		9.60
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	9.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	10.0
Sodium	mg/l	100.
Magnesium	mg/l	160.
Bicarbonate	mg/l	675.
Ammonia-Nitrogen	mg/l	0.300
Nitrogen-Nitrate	mg/l	<0.002
Nitrogen-Nitrite	mg/l	<0.100
Phenols	mg/l	0.021
Chromium	mg/l	<0.010
Cadmium	mg/l	<0.020
Lead	mg/l	0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1840.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 5-D Up Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	605.12	605.45	604.84
COD	mg/l			
Iron	mg/l	1.70	1.20	0.880
Chloride	mg/l	140.	150.	140.
Sulfate	mg/l	190.	200.	70.0
Sp. Conductance	umhos/cm	2160.	1990.	1785.
Sp. Conductance	umhos/cm	2109.	1918.	1800.
Sp. Conductance	umhos/cm	2121.	1939.	1791.
Sp. Conductance	umhos/cm	2100.	1954.	1860.
pH 1		7.32	7.44	10.2
pH 2		7.28	7.50	10.2
pH 3		7.31	7.67	10.2
pH 4		7.32	7.60	10.2
TOC 1	mg/l	6.00	21.0	21.0
TOC 2	mg/l	5.00	18.0	20.0
TOC 3	mg/l	5.00	13.0	9.00
TOC 4	mg/l	6.00	20.0	33.0
Calcium	mg/l			
Sodium	mg/l	85.0	88.0	180.
Magnesium	mg/l			
Bicarbonate	mg/l			
Ammonia-Nitrogen	mg/l			
Nitrogen-Nitrate	mg/l	0.010	0.250	<0.010
Nitrogen-Nitrite	mg/l			
Phenols	mg/l	<0.004	<0.004	<0.004
Chromium	mg/l	<0.005	0.016	0.019
Cadmium	mg/l	0.006	<0.003	<0.003
Lead	mg/l	0.010	<0.010	0.091
Napthalene	mg/l			

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 5-D Up Gradient

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet	604.24	605.44
COD	mg/l	-	27.0
Iron	mg/l		1.70
Chloride	mg/l		160.
Sulfate	mg/l		190.
Sp. Conductance	umhos/cm		1600.
Sp. Conductance	umhos/cm		1600.
Sp. Conductance	umhos/cm		1600.
Sp. Conductance	umhos/cm		1600.
pH 1			8.00
pH 2			8.00
pH 3			8.00
pH 4			8.00
TOC 1	mg/l		7.00
TOC 2	mg/l		11.0
TOC 3	mg/l		9.00
TOC 4	mg/l		8.00
Calcium	mg/l		38.0
Sodium	mg/l		110.
Magnesium	mg/l		240.
Bicarbonate	mg/l		600.
Ammonia-Nitrogen	mg/l		0.830
Nitrogen-Nitrate	mg/l		0.020
Nitrogen-Nitrite	mg/l		<0.020
Phenols	mg/l		
Chromium	mg/l		<0.020
Cadmium	mg/l		
Lead	mg/l		0.100
Napthalene	mg/l		

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 5-D Up Gradient

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	603.93
COD	mg/l	<4.00
Iron	mg/l	0.110
Chloride	mg/l	150.
Sulfate	mg/l	300.
Sp. Conductance	umhos/cm	1700.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		9.30
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	3.60
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	11.0
Sodium	mg/l	110.
Magnesium	mg/l	160.
Bicarbonate	mg/l	450.
Ammonia-Nitrogen	mg/l	0.600
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Time of Execution: 06/15/84 0933.0 edt Fri

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 7-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	591.81
COD	mg/l	1.90
Iron	mg/l	0.030
Chloride	mg/l	150.
Sulfate	mg/l	1300.
Sp. Conductance	umhos/cm	2250.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		10.0
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	7.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	370.
Sodium	mg/l	120.
Magnesium	mg/l	24.0
Bicarbonate	mg/l	0.0000
Ammonia-Nitrogen	mg/l	0.750
Nitrogen-Nitrate	mg/l	0.100
Nitrogen-Nitrite	mg/l	0.002
Phenols	mg/l	0.023
Chromium	mg/l	0.010
Cadmium	mg/l	0.020
Lead	mg/l	0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 7-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	589.60	582.06	586.35
COD	mg/l	200.	160.	260.
Iron	mg/l	3.30	20.0	3.40
Chloride	mg/l		160.	140.
Sulfate	mg/l	850.	1000.	880.
Sp. Conductance	umhos/cm	1800.	2664.	2435.
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
pH 1		9.80	10.0	10.0
pH 2				
pH 3				
pH 4				
TOC 1	mg/l	85.0	31.0	49.0
TOC 2	mg/l			
TOC 3	mg/l			
TOC 4	mg/l			
Calcium	mg/l	270.		
Sodium	mg/l			260.
Magnesium	mg/l	48.0		
Bicarbonate	mg/l	39.0		
Ammonia-Nitrogen	mg/l			0.630
Nitrogen-Nitrate	mg/l			0.080
Nitrogen-Nitrite	mg/l			0.020
Phenols	mg/l			
Chromium	mg/l	0.020		
Cadmium	mg/l			
Lead	mg/l			0.440
Napthalene	mg/l			

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 7-D Down Gradient

Date Sampled: 08-24-83

Parameter	Units	
Static	Feet	592.05
COD	mg/l	160.
Iron	mg/l	14.0
Chloride	mg/l	180.
Sulfate	mg/l	1160.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
pH 1		10.6
pH 2		10.8
pH 3		10.8
pH 4		10.8
TOC 1	mg/l	49.0
TOC 2	mg/l	28.0
TOC 3	mg/l	42.0
TOC 4	mg/l	21.0
Calcium	mg/l	450.
Sodium	mg/l	150.
Magnesium	mg/l	18.0
Bicarbonate	mg/l	40.0
Ammonia-Nitrogen	mg/l	0.940
Nitrogen-Nitrate	mg/l	0.040
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	1.00
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 7-D Down Gradient

Parameter	Units	Date Sampled. 04-17-84
Static	Feet	592.04
COD	mg/l	130.
Iron	mg/l	0.530
Chloride	mg/l	160.
Sulfate	mg/l	2500.
Sp. Conductance	umhos/cm	2400.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		9.90
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	35.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	280.
Sodium	mg/l	110.
Magnesium	mg/l	15.0
Bicarbonate	mg/l	0.0000
Ammonia-Nitrogen	mg/l	0.900
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Time of Execution: 06/15/84 0933.0 edt Fri

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 10-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	601.81
COD	mg/l	7.00
Iron	mg/l	0.240
Chloride	mg/l	150.
Sulfate	mg/l	2100.
Sp. Conductance	umhos/cm	3000.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.80
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	7.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	370.
Sodium	mg/l	90.0
Magnesium	mg/l	200.
Bicarbonate	mg/l	225.
Ammonia-Nitrogen	mg/l	0.500
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	0.002
Phenols	mg/l	0.009
Chromium	mg/l	0.010
Cadmium	mg/l	0.020
Lead	mg/l	0.050
Napthalene	mg/l	

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 10-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	601.28	588.03	596.63
COD	mg/l	140.	300.	230.
Iron	mg/l	4.30	0.520	5.90
Chloride	mg/l		160.	140.
Sulfate	mg/l	1800.	1900.	1600.
Sp. Conductance	umhos/cm	3240.	1238.	2898.
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
pH 1		7.20	7.94	9.10
pH 2				
pH 3				
pH 4				
TOC 1	mg/l	27.0	68.0	21.0
TOC 2	mg/l			
TOC 3	mg/l			
TOC 4	mg/l			
Calcium	mg/l	290.		
Sodium	mg/l			210.
Magnesium	mg/l	220.		
Bicarbonate	mg/l	200.		
Ammonia-Nitrogen	mg/l			0.550
Nitrogen-Nitrate	mg/l			0.040
Nitrogen-Nitrite	mg/l			0.010
Phenols	mg/l			
Chromium	mg/l	0.010		
Cadmium	mg/l			
Lead	mg/l			0.050
Napthalene	mg/l			

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 10-D Down Gradient

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet	598.45	
COD	mg/l		
Iron	mg/l		
Chloride	mg/l		
Sulfate	mg/l		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
pH 1			
pH 2			
pH 3			
pH 4			
TOC 1	mg/l		
TOC 2	mg/l		
TOC 3	mg/l		
TOC 4	mg/l		
Calcium	mg/l		
Sodium	mg/l		
Magnesium	mg/l		
Bicarbonate	mg/l		
Ammonia-Nitrogen	mg/l		
Nitrogen-Nitrate	mg/l		
Nitrogen-Nitrite	mg/l		
Phenols	mg/l		
Chromium	mg/l		
Cadmium	mg/l		
Lead	mg/l		
Napthalene	mg/l		

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 101-D Down Gradient

Parameter	Units	Date Sampled 04-17-84
Static	Feet	595.92
COD	mg/l	190.
Iron	mg/l	27.0
Chloride	mg/l	150.
Sulfate	mg/l	2600.
Sp. Conductance	umhos/cm	2400.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.40
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	19.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	180.
Sodium	mg/l	120.
Magnesium	mg/l	150.
Bicarbonate	mg/l	260.
Ammonia-Nitrogen	mg/l	0.850
Nitrogen-Nitrate	mg/l	0.020
Nitrogen-Nitrite	mg/l	0.030
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Time of Execution: 06/15/84 0933.6 edt Fri

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 101-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	601.21
COD	mg/l	1.60
Iron	mg/l	0.030
Chloride	mg/l	135.
Sulfate	mg/l	1250.
Sp. Conductance	umhos/cm	2400.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.10
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	11.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	190.
Sodium	mg/l	120.
Magnesium	mg/l	140.
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	0.500
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	0.004
Phenols	mg/l	
Chromium	mg/l	0.010
Cadmium	mg/l	
Lead	mg/l	0.050
Napthalene	mg/l	

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 101-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	597.89	597.81	599.77
COD	mg/l	200.	210.	250.
Iron	mg/l	2.20	0.940	3.80
Chloride	mg/l		150.	140.
Sulfate	mg/l	1000.	1000.	960.
Sp. Conductance	umhos/cm	2802.	2207.	2204.
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
pH 1		7.10	7.62	8.60
pH 2				
pH 3				
pH 4				
TOC 1	mg/l	60.0	44.0	43.0
TOC 2	mg/l			
TOC 3	mg/l			
TOC 4	mg/l			
Calcium	mg/l	180.		
Sodium	mg/l			240.
Magnesium	mg/l	160.		
Bicarbonate	mg/l	130.		
Ammonia-Nitrogen	mg/l			0.500
Nitrogen-Nitrate	mg/l			0.870
Nitrogen-Nitrite	mg/l			<0.010
Phenols	mg/l			
Chromium	mg/l	0.010		
Cadmium	mg/l			
Lead	mg/l			0.110
Napthalene	mg/l			

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 101-D Down Gradient

Parameter	Units	Date Sampled: 08-24-83
Static	Feet	600.26
COD	mg/l	90.0
Iron	mg/l	17.0
Chloride	mg/l	200.
Sulfate	mg/l	1360.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
Sp. Conductance	umhos/cm	2200.
pH 1		7.70
pH 2		7.70
pH 3		7.70
pH 4		7.70
TOC 1	mg/l	17.0
TOC 2	mg/l	8.00
TOC 3	mg/l	22.0
TOC 4	mg/l	17.0
Calcium	mg/l	190.
Sodium	mg/l	150.
Magnesium	mg/l	230.
Bicarbonate	mg/l	170.
Ammonia-Nitrogen	mg/l	0.610
Nitrogen-Nitrate	mg/l	0.210
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	<0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 101-D Down Gradient

Parameter	Units	Date Sampled 04-17-84
Static	Feet	595.92
COD	mg/l	190.
Iron	mg/l	27.0
Chloride	mg/l	150
Sulfate	mg/l	2600
Sp. Conductance	umhos/cm	2400.
Sp Conductance	umhos/cm	
Sp Conductance	umhos/cm	
Sp Conductance	umhos/cm	
pH 1		7.40
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	19.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	186.
Sodium	mg/l	126.
Magnesium	mg/l	150.
Bicarbonate	mg/l	260.
Ammonia-Nitrogen	mg/l	0.850
Nitrogen-Nitrate	mg/l	0.020
Nitrogen-Nitrite	mg/l	0.030
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Time of Execution: 06/15/84 0923.6 edt Fri

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 102-D Down GraDient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	603.22
COD	mg/l	0.600
Iron	mg/l	<0.030
Chloride	mg/l	130.
Sulfate	mg/l	1200.
Sp. Conductance	umhos/cm	2500.
Sp. Conductance	umhos/cm	2450.
Sp. Conductance	umhos/cm	2300.
Sp. Conductance	umhos/cm	2300.
pH 1		8.40
pH 2		8.10
pH 3		8.10
pH 4		8.10
TOC 1	mg/l	5.60
TOC 2	mg/l	6.00
TOC 3	mg/l	5.60
TOC 4	mg/l	6.60
Calcium	mg/l	160.
Sodium	mg/l	100.
Magnesium	mg/l	210.
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	0.500
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	0.002
Phenols	mg/l	0.005
Chromium	mg/l	<0.010
Cadmium	mg/l	<0.010
Lead	mg/l	<0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 102-D Down GraDient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	601.77	601.68	599.15
COD	mg/l			
Iron	mg/l	0.530	5.10	1.20
Chloride	mg/l	140.	140.	140.
Sulfate	mg/l	910.	960.	810.
Sp. Conductance	umhos/cm	2993.	2524.	2392.
Sp. Conductance	umhos/cm	2997.	2664.	2398.
Sp. Conductance	umhos/cm	2973.	2651.	2358.
Sp. Conductance	umhos/cm	2940.	2630.	2378.
pH 1		7.30	7.20	8.70
pH 2		7.30	7.20	6.70
pH 3		7.30	7.20	6.70
pH 4		7.30	7.30	8.70
TOC 1	mg/l	9.00	21.0	16.0
TOC 2	mg/l	12.0	15.0	24.0
TOC 3	mg/l	11.0	19.0	23.0
TOC 4	mg/l	13.0	17.0	16.0
Calcium	mg/l			
Sodium	mg/l	95.0	97.0	200.
Magnesium	mg/l			
Bicarbonate	mg/l			
Ammonia-Nitrogen	mg/l			
Nitrogen-Nitrate	mg/l	<0.010	0.270	<0.010
Nitrogen-Nitrite	mg/l			
Phenols	mg/l	<0.004	<0.004	<0.004
Chromium	mg/l	<0.005	0.006	0.008
Cadmium	mg/l	0.008	<0.003	<0.003
Lead	mg/l	0.010	<0.010	<0.010
Napthalene	mg/l			

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 102-D Down GraDient

Parameter	Units	04-26-83	08-24-83
Static	Feet	602.41	601.89
COD	mg/l		74.0
Iron	mg/l		19.0
Chloride	mg/l		170.
Sulfate	mg/l		1210.
Sp. Conductance	umhos/cm		2500.
Sp. Conductance	umhos/cm		2500.
Sp. Conductance	umhos/cm		2500.
Sp. Conductance	umhos/cm		2400.
pH 1			7.70
pH 2			7.60
pH 3			7.60
pH 4			7.70
TOC 1	mg/l		17.0
TOC 2	mg/l		16.0
TOC 3	mg/l		11.0
TOC 4	mg/l		9.00
Calcium	mg/l		160.
Sodium	mg/l		120.
Magnesium	mg/l		330.
Bicarbonate	mg/l		390.
Ammonia-Nitrogen	mg/l		0.940
Nitrogen-Nitrate	mg/l		0.030
Nitrogen-Nitrite	mg/l		<0.020
Phenols	mg/l		
Chromium	mg/l		<0.020
Cadmium	mg/l		
Lead	mg/l		<0.050
Napthalene	mg/l		

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 102-D Down GraDient

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	601.49
COD	mg/l	23.0
Iron	mg/l	7.00
Chloride	mg/l	39.0
Sulfate	mg/l	2500.
Sp. Conductance	umhos/cm	2500.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.20
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	3.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	170.
Sodium	mg/l	95.0
Magnesium	mg/l	210.
Bicarbonate	mg/l	450.
Ammonia-Nitrogen	mg/l	1.00
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	0.210
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 103-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	603.52
COD	mg/l	1.60
Iron	mg/l	<0.030
Chloride	mg/l	25.0
Sulfate	mg/l	46.0
Sp. Conductance	umhos/cm	300.
Sp. Conductance	umhos/cm	300.
Sp. Conductance	umhos/cm	300.
Sp. Conductance	umhos/cm	300.
pH 1		8.60
pH 2		8.30
pH 3		8.40
pH 4		8.50
TOC 1	mg/l	5.60
TOC 2	mg/l	6.00
TOC 3	mg/l	5.60
TOC 4	mg/l	6.60
Calcium	mg/l	37.0
Sodium	mg/l	6.00
Magnesium	mg/l	6.20
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	0.400
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	<0.002
Phenols	mg/l	<0.005
Chromium	mg/l	<0.010
Cadmium	mg/l	<0.010
Lead	mg/l	<0.050
Napthalene	mg/l	

Time of Execution: 06/19/84 1040.3 edt Tue

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 103-D Down Gradient

Parameter	Units	05-06-82	07-14-82	10-26-82
Date Sampled:		05-06-82	07-14-82	10-26-82
Static	Feet	603.65	601.23	601.26
COD	mg/l			
Iron	mg/l	1.00	0.900	6.00
Chloride	mg/l	130.	140.	130.
Sulfate	mg/l	760.	790.	840.
Sp. Conductance	umhos/cm	2622.	2441.	2352.
Sp. Conductance	umhos/cm	2604.	2468.	2308.
Sp. Conductance	umhos/cm	2583.	2450.	2294.
Sp. Conductance	umhos/cm	2616.	2438.	2288.
pH 1		7.02	7.70	6.70
pH 2		7.09	7.70	8.70
pH 3		7.11	7.70	8.70
pH 4		7.12	7.70	8.70
TOC 1	mg/l	4.00	12.0	26.0
TOC 2	mg/l	5.00	14.0	21.0
TOC 3	mg/l	6.00	14.0	22.0
TOC 4	mg/l	6.00	9.00	21.0
Calcium	mg/l			
Sodium	mg/l	8.70	85.0	160.
Magnesium	mg/l			
Bicarbonate	mg/l			
Ammonia-Nitrogen	mg/l			
Nitrogen-Nitrate	mg/l	<0.010	0.050	<0.010
Nitrogen-Nitrite	mg/l			
Phenols	mg/l	<0.004	0.006	
Chromium	mg/l	0.020	<0.004	<0.005
Cadmium	mg/l	0.007	0.008	<0.003
Lead	mg/l	<0.010	<0.010	<0.010
Napthalene	mg/l			

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 103-D Down Gradient

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet	602.31	603.23
COD	mg/l		20.0
Iron	mg/l		1.70
Chloride	mg/l		170.
Sulfate	mg/l		970.
Sp. Conductance	umhos/cm		2300.
Sp. Conductance	umhos/cm		2200.
Sp. Conductance	umhos/cm		2200.
Sp. Conductance	umhos/cm		2200.
pH 1			8.00
pH 2			8.00
pH 3			7.90
pH 4			7.90
TOC 1	mg/l		11.0
TOC 2	mg/l		10.0
TOC 3	mg/l		17.0
TOC 4	mg/l		21.0
Calcium	mg/l		99.0
Sodium	mg/l		100.
Magnesium	mg/l		310.
Bicarbonate	mg/l		440.
Ammonia-Nitrogen	mg/l		0.740
Nitrogen-Nitrate	mg/l		0.030
Nitrogen-Nitrite	mg/l		<0.020
Phenols	mg/l		
Chromium	mg/l		<0.020
Cadmium	mg/l		
Lead	mg/l		<0.050
Napthalene	mg/l		

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 103-D Down Gradient

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	601.36
COD	mg/l	<4.00
Iron	mg/l	0.310
Chloride	mg/l	130.
Sulfate	mg/l	1900.
Sp. Conductance	umhos/cm	2300.
Sp Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.50
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	4.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	73.0
Sodium	mg/l	98.0
Magnesium	mg/l	240.
Bicarbonate	mg/l	410.
Ammonia-Nitrogen	mg/l	0.800
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 104-D Down Gradient

Parameter	Units	Date Sampled: 08-10-81
Static	Feet	603.81
COD	mg/l	1.00
Iron	mg/l	0.320
Chloride	mg/l	140.
Sulfate	mg/l	1350.
Sp. Conductance	umhos/cm	2550.
Sp. Conductance	umhos/cm	2500.
Sp. Conductance	umhos/cm	2400.
Sp. Conductance	umhos/cm	2400.
pH 1		8.00
pH 2		8.00
pH 3		8.00
pH 4		8.10
TOC 1	mg/l	6.00
TOC 2	mg/l	6.80
TOC 3	mg/l	6.60
TOC 4	mg/l	6.60
Calcium	mg/l	310.
Sodium	mg/l	100.
Magnesium	mg/l	180.
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	0.500
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	<0.002
Phenols	mg/l	<0.005
Chromium	mg/l	<0.010
Cadmium	mg/l	<0.010
Lead	mg/l	<0.050
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 104-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82
Static	Feet	604.32	604.32
COD	mg/l		
Iron	mg/l	4.30	9.90
Chloride	mg/l	150.	160.
Sulfate	mg/l	1200.	1300.
Sp. Conductance	umhos/cm	1980.	2617.
Sp. Conductance	umhos/cm	1960.	2885.
Sp. Conductance	umhos/cm	1920.	2885.
Sp. Conductance	umhos/cm	1980.	2852.
pH 1		6.89	7.70
pH 2		6.90	7.68
pH 3		6.91	7.68
pH 4		6.90	7.67
TOC 1	mg/l	7.00	6.00
TOC 2	mg/l	10.0	12.0
TOC 3	mg/l	8.00	14.0
TOC 4	mg/l	8.00	12.0
Calcium	mg/l		
Sodium	mg/l	100.	88.0
Magnesium	mg/l		
Bicarbonate	mg/l		
Ammonia-Nitrogen	mg/l		
Nitrogen-Nitrate	mg/l	<0.010	0.230
Nitrogen-Nitrite	mg/l		
Phenols	mg/l	<0.004	<0.004
Chromium	mg/l	<0.005	0.012
Cadmium	mg/l	0.010	<0.003
Lead	mg/l	<0.010	<0.010
Napthalene	mg/l		

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 104-D Down Gradient

Parameter	Units	Date Sampled: 10-26-83	04-26-83	08-24-83
Static	Feet	604.12	601.39	603.73
COD	mg/l			16.0
Iron	mg/l	52.0		17.0
Chloride	mg/l	140.		170.
Sulfate	mg/l	1200.		1580.
Sp. Conductance	umhos/cm	2898.		2600.
Sp. Conductance	umhos/cm	2862.		2600.
Sp. Conductance	umhos/cm	2838.		2600.
Sp. Conductance	umhos/cm	2871.		2600.
pH 1		8.30		7.60
pH 2		8.20		7.50
pH 3		8.20		7.40
pH 4		8.20		7.40
TOC 1	mg/l	11.0		8.00
TOC 2	mg/l	15.0		7.00
TOC 3	mg/l	10.0		[illegible].00
TOC 4	mg/l	12.0		7.00
Calcium	mg/l			330.
Sodium	mg/l	210.		100.
Magnesium	mg/l			230.
Bicarbonate	mg/l			240.
Ammonia-Nitrogen	mg/l			0.830
Nitrogen-Nitrate	mg/l	0.250		0.380
Nitrogen-Nitrite	mg/l			<0.020
Phenols	mg/l	<0.004		
Chromium	mg/l	0.013		<0.020
Cadmium	mg/l	<0.003		
Lead	mg/l	0.020		<0.050
Napthalene	mg/l			

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 104-D Down Gradient

Parameter	Units	Date Sampled: 04-17-84
Static	Feet	603.04
COD	mg/l	<4.00
Iron	mg/l	4.20
Chloride	mg/l	150.
Sulfate	mg/l	3100.
Sp. Conductance	umhos/cm	2600.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.26
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	3.00
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	220.
Sodium	mg/l	100.
Magnesium	mg/l	186.
Bicarbonate	mg/l	220.
Ammonia-Nitrogen	mg/l	1.00
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 105-D Down Gradient

Date Sampled: 08-10-81

Parameter	Units	
Static	Feet	603.86
COD	mg/l	1.00
Iron	mg/l	1.40
Chloride	mg/l	145.
Sulfate	mg/l	1300.
Sp. Conductance	umhos/cm	2600.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.10
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	11.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	330.
Sodium	mg/l	90.0
Magnesium	mg/l	150.
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	0.400
Nitrogen-Nitrate	mg/l	<0.100
Nitrogen-Nitrite	mg/l	<0.002
Phenols	mg/l	
Chromium	mg/l	0.010
Cadmium	mg/l	
Lead	mg/l	0.050
Napthalene	mg/l	

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 105-D Down Gradient

Parameter	Units	Date Sampled: 05-06-82	07-14-82	10-26-82
Static	Feet	603.87	604.00	603.50
COD	mg/l	2.00	41.0	110.
Iron	mg/l	2.80	3.40	4.30
Chloride	mg/l		160.	140.
Sulfate	mg/l	1400.	1300.	1100.
Sp. Conductance	umhos/cm	2300.	3084.	2216.
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
pH 1		7.02	7.00	8.10
pH 2				
pH 3				
pH 4				
TOC 1	mg/l	3.00	10.0	9.00
TOC 2	mg/l			
TOC 3	mg/l			
TOC 4	mg/l			
Calcium	mg/l	270.		
Sodium	mg/l			200.
Magnesium	mg/l	170.		
Bicarbonate	mg/l	220.		
Ammonia-Nitrogen	mg/l			0.410
Nitrogen-Nitrate	mg/l			0.010
Nitrogen-Nitrite	mg/l			0.010
Phenols	mg/l			
Chromium	mg/l	0.010		
Cadmium	mg/l			
Lead	mg/l			0.020
Napthalene	mg/l			

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 105-D Down Gradient

Parameter	Units	Date Sampled: 08-24-83
Static	Feet	603.87
COD	mg/l	39.0
Iron	mg/l	2.10
Chloride	mg/l	170.
Sulfate	mg/l	1510.
Sp. Conductance	umhos/cm	2800.
Sp. Conductance	umhos/cm	2800.
Sp. Conductance	umhos/cm	2800.
Sp. Conductance	umhos/cm	2800.
pH 1		7.60
pH 2		7.60
pH 3		7.60
pH 4		7.50
TOC 1	mg/l	11.0
TOC 2	mg/l	9.00
TOC 3	mg/l	6.00
TOC 4	mg/l	10.0
Calcium	mg/l	440.
Sodium	mg/l	120.
Magnesium	mg/l	240.
Bicarbonate	mg/l	260.
Ammonia-Nitrogen	mg/l	0.580
Nitrogen-Nitrate	mg/l	0.080
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	<0.050
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Well: 105-D Down Gradient

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	602.91
COD	mg/l	<4.00
Iron	mg/l	2.00
Chloride	mg/l	150.
Sulfate	mg/l	3100.
Sp. Conductance	umhos/cm	2700.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		6.90
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	12.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	240.
Sodium	mg/l	100.
Magnesium	mg/l	150.
Bicarbonate	mg/l	210.
Ammonia-Nitrogen	mg/l	0.750
Nitrogen-Nitrate	mg/l	<0.020
Nitrogen-Nitrite	mg/l	<0.020
Phenols	mg/l	
Chromium	mg/l	<0.020
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Sediment Pond

Parameter	Units	Date Sampled: 05-25-82	07-14-82	10-25-82
Static	Feet			
COD	mg/l			
Iron	mg/l			
Chloride	mg/l			
Sulfate	mg/l			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
Sp. Conductance	umhos/cm			
pH 1				
pH 2				
pH 3				
pH 4				
TOC 1	mg/l			
TOC 2	mg/l			
TOC 3	mg/l			
TOC 4	mg/l			
Calcium	mg/l			
Sodium	mg/l			
Magnesium	mg/l			
Bicarbonate	mg/l			
Ammonia-Nitrogen	mg/l			
Nitrogen-Nitrate	mg/l			
Nitrogen-Nitrite	mg/l			
Phenols	mg/l	<0.004	0.007	0.004
Chromium	mg/l	0.009	0.006	0.007
Cadmium	mg/l	<0.003	<0.003	0.003
Lead	mg/l	<0.010	0.010	0.010
Napthalene	mg/l	0.0005	0.005	0.005

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Sediment Pond

Parameter	Units	Date Sampled: 02-23-83	08-24-83
Static	Feet		
COD	mg/l		
Iron	mg/l		
Chloride	mg/l		
Sulfate	mg/l		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
Sp. Conductance	umhos/cm		
pH 1			
pH 2			
pH 3			
pH 4			
TOC 1	mg/l		
TOC 2	mg/l		
TOC 3	mg/l		
TOC 4	mg/l		
Calcium	mg/l		
Sodium	mg/l		
Magnesium	mg/l		
Bicarbonate	mg/l		
Ammonia-Nitrogen	mg/l		
Nitrogen-Nitrate	mg/l		
Nitrogen-Nitrite	mg/l		
Phenols	mg/l	<0.010	<10.0
Chromium	mg/l	<0.020	<0.020
Cadmium	mg/l	<0.010	<0.010
Lead	mg/l	<0.050	<0.050
Napthalene	mg/l	<0.010	<0.005

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Sediment Pond

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	
COD	mg/l	
Iron	mg/l	
Chloride	mg/l	
Sulfate	mg/l	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	
Sodium	mg/l	
Magnesium	mg/l	
Bicarbonate	mg/l	
Ammonia-Nitrogen	mg/l	
Nitrogen-Nitrate	mg/l	
Nitrogen-Nitrite	mg/l	
Phenols	mg/l	<0.002
Chromium	mg/l	<0.020
Cadmium	mg/l	0.010
Lead	mg/l	<0.050
Napthalene	mg/l	<0.001

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Allen Drain

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet		
COD	mg/l	36.0	4.00
Iron	mg/l	0.560	1.00
Chloride	mg/l	210.	120.
Sulfate	mg/l	560.	460.
Sp. Conductance	umhos/cm	1800.	
Sp. Conductance	umhos/cm	1800.	
Sp. Conductance	umhos/cm	1800.	
Sp. Conductance	umhos/cm	1800.	
pH 1		7.20	
pH 2		7.20	
pH 3		7.20	
pH 4		7.20	
TOC 1	mg/l	33.0	15.0
TOC 2	mg/l		15.0
TOC 3	mg/l		16.0
TOC 4	mg/l		15.0
Calcium	mg/l		150.
Sodium	mg/l		80.0
Magnesium	mg/l		37.0
Bicarbonate	mg/l		120.
Ammonia-Nitrogen	mg/l		0.330
Nitrogen-Nitrate	mg/l		0.020
Nitrogen-Nitrite	mg/l		<0.020
Phenols	mg/l		
Chromium	mg/l		<0.020
Cadmium	mg/l		
Lead	mg/l		<0.050
Napthalene	mg/l		

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Tyre Drain

Parameter	Units	Date Sampled: 04-26-83	08-24-83
Static	Feet		
COD	mg/l	80.0	
Iron	mg/l	0.650	
Chloride	mg/l	590.	
Sulfate	mg/l	210.	
Sp. Conductance	umhos/cm	1518.	
Sp. Conductance	umhos/cm	1518.	
Sp. Conductance	umhos/cm	1518.	
Sp. Conductance	umhos/cm	1518.	
pH 1		6.90	
pH 2		6.90	
pH 3		6.90	
pH 4		6.90	
TOC 1	mg/l	24.0	
TOC 2	mg/l		
TOC 3	mg/l		
TOC 4	mg/l		
Calcium	mg/l		
Sodium	mg/l		
Magnesium	mg/l		
Bicarbonate	mg/l		
Ammonia-Nitrogen	mg/l		
Nitrogen-Nitrate	mg/l		
Nitrogen-Nitrite	mg/l		
Phenols	mg/l		
Chromium	mg/l		
Cadmium	mg/l		
Lead	mg/l		
Napthalene	mg/l		

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Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Allen Drain

Date Sampled. 04-17-84

Parameter	Units	
Static	Feet	
COD	mg/l	16.0
Iron	mg/l	0.460
Chloride	mg/l	186.
Sulfate	mg/l	736.
Sp Conductance	umhos/cm	1700.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.20
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	26.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	110.
Sodium	mg/l	126.
Magnesium	mg/l	35.0
Bicarbonate	mg/l	160.
Ammonia-Nitrogen	mg/l	0.750
Nitrogen-Nitrate	mg/l	0.460
Nitrogen-Nitrite	mg/l	0.050
Phenols	mg/l	
Chromium	mg/l	0.636
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

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E-3 Aquifer Identification 40 CFR 270.14(c)(2)

There are two sand formations on site. The uppermost formation is a beach sand deposit that varies from 0-8' in thickness but is limited in regional extent due to excavations and construction projects in the vicinity. These sands are water bearing when the perimeter surface drain is in a state of efflux.

Since this formation lies above the disposal cell lined walls, there is no potential for migration of leachate from the regulated unit into this formation. Under these conditions, the provisions under 40 CFR 270.14(c)(2) thru 270.14(c)(8) do not apply.

The uppermost aquifer is then identified as being the sand formation lying approximately 80 feet below grade.

E-4 through E-8 not applicable per E-1.

Section F -
Procedures to Prevent Hazards

6. Storm Water - Insure that storm water collected in the inactive areas does not come in contact with active work areas. Inspect integrity of diversion berms in the cell in order to maintain separation of active from inactive work areas. Inspect run-on and run-off diversion berms and dikes for erosion or general damage that would allow water into the waste management area.

7. Leachate System - Inspect record and sample the following system components.

   a) Primary and Secondary Pump Systems.
      1. Switching mechanisms operable.
      2. Pumps operable.
      3. Verify liquid volumes in sump.

   b) Primary Leachate Holding Tanks.
      1. Monitor secondary containment.
      2. Monitor leachate volume.
      3. Sample leachate (if necessary).

   c) Secondary Holding Tanks
      1. Monitor liquid volume.
      2. Sample and analyse liquid (if necessary).

   d) Discharge Lines.
      1. Inspect for damage (clean-outs)

   e) Sampling Manhole.
      1. Proper flow recording.
      2. Proper leachate discharge.

F-2 General Inspection Requirements 40 CFR 270.14(b)(5)

F-2b Landfill Inspection 40 CFR 264.303(b)

The general inspection schedule and the inspection procedures for the facility are provided in Attachment 18. The backside of the inspection schedule is used for detailed notations and explanations or observations. The inspector initials the items which were checked and provides the date and time of inspections.

F-3 Equipment Requirements 40 CFR 270.14(b)(6)

The hazardous wastes handled at the facility are not considered to be "acutely toxic". Accordingly, an internal communications or alarm system is not necessary. A telephone is available for external communications at the manifest office trailer for summoning general emergency assistance. The hazardous waste management area is in view from the manifest office trailer. Fire extinguishers are available for the manifest office trailer and mobile equipment. Water is available on site in ditches and the pond as well as a fire hydrant. The wastes disposed of are not flammable. Due to the facility layout, aisle space requirements have been met.

Attachment 18

Hazardous Waste

General Inspection Procedures

Ford Motor Company - Allen Park Clay Mine Landfill

A. Surveillance Schedules and Procedures

During hours of operation, surveillance is the responsibility of the supervising inspector, check-in trailer staff as well as operators at the active fill area. In addition, the landfill is periodically patrolled by Ford security personnel. During hours when the site is closed, the only entry gate is locked preventing unauthorized entry. Refer to Site Security Plan.

B. Routine Maintenance Procedures and Schedules

To minimize the possibility of unplanned sudden or non-sudden releases of hazardous wastes or hazardous waste constituents to air, soil or water, routine facility inspections are conducted and maintenance performed as required. The following checklist is utilized:

Daily Items - Monday Through Friday and After Storms

1. Proper Disposal - Insure that proper wastes are unloaded and landfilled in the appropriate location.
2. Gate Security - Insure the proper functioning of the gate and lock.
3. Access Road - Inspect the road for repairs, proper cleaning or dust suppression.
4. Warning Signs - Insure that appropriate warning signs are visible.
5. Daily Cover - Insure that cover material is available and that incoming wastes are covered daily.

Allen Park Clay Mine

Ground Water Monitoring Data

Additional Water Quality Parameters

Allen Drain

Date Sampled: 04-17-84

Parameter	Units	
Static	Feet	
COD	mg/l	16.0
Iron	mg/l	0.460
Chloride	mg/l	180.
Sulfate	mg/l	730.
Sp. Conductance	umhos/cm	1700.
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
Sp. Conductance	umhos/cm	
pH 1		7.20
pH 2		
pH 3		
pH 4		
TOC 1	mg/l	20.0
TOC 2	mg/l	
TOC 3	mg/l	
TOC 4	mg/l	
Calcium	mg/l	110.
Sodium	mg/l	120.
Magnesium	mg/l	35.0
Bicarbonate	mg/l	160.
Ammonia-Nitrogen	mg/l	0.750
Nitrogen-Nitrate	mg/l	0.460
Nitrogen-Nitrite	mg/l	0.050
Phenols	mg/l	
Chromium	mg/l	0.030
Cadmium	mg/l	
Lead	mg/l	
Napthalene	mg/l	

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Ford Allen Park Clay Mine

MID 980568711

Section F Procedures to Prevent Hazards

F-1 **Security Procedures** 40 CFR 270.14(b)(4)

We believe that physical contact with the wastes, structures or equipment within the active portion of the facility is not likely to injure unknowing or unauthorized persons or livestock. However, security measures have been taken in satisfaction of 264.14(b)(2) and (c) as stated in the Site Security Plan (Attachment 17).

FORD MOTOR COMPANY ALLEN PARK CLAY MINE

MID 980568711

SITE SECURITY PLAN

1. All entry to the facility is through one main gate located off Oakwood Boulevard, between Interstate 94 and Southfield Freeway. During hours of operation, all vehicles and visitors must pass by an attended check-in trailer for entry.

2. The operational hours for the hazardous waste site is 7:00 a.m. to 3:00 p.m., Monday through Friday. The solid waste site is open 16 hours per day, Monday through Friday.

3. A six foot cyclone fence topped with three strand barbed wire has been constructed around the entire perimeter of the site. Surface water drains and large screening berms on the site perimeter further impede unknowing or unauthorized entry by persons or animals.

4. Warning signs that read "No Trespassing - Violators will be Prosecuted" are affixed to the perimeter fence at intermittent spacing which will discourage unauthorized entry.

5. Physical contact with the wastes, structures, or equipment with the active portion of the facility will not injure unknowing or unauthorized persons or livestock which may enter the active portion of the facility.

6. Warning signs that read "Danger Unauthorized Personnel Keep Out" are posted at each entrance to the active portion of the facility in

sufficient numbers to be seen from any approach to the active area.

7. Entrance gate is locked by manifest checker when facility is closed.
8. Ford Motor Company Rouge Plant Security provides additional security coverage on an inspection audit basis.

8. Bulldozer - Insure bulldozer is operable.

9. Telephone - Insure operation of phone.

Weekly Items

1. Fire extinguishers - Check the availability and pressure gauges on the fire extinguishers. Extinguishers are in Manifest Trailer and mobile operating equipment.
2. Gauze Masks - Verify that the gauze masks are available.
3. Perimeter Fence - Look for locations where the fence is in disrepair.
4. Surface Drains - Look for blocked drainage and surface water contamination.
5. Sediment Basin - Check the outflow for blocked drainage and surface water contamination.
6. Intermediate cover - Inspect all fill areas that do not have final cover to insure that intermediate cover is adequate. Inspect for erosion or other damage that could or has exposed wastes.

Quarterly Items

1. Monitor Wells - Inspect integrity of protective casings, including caps and locks.
2. Final cover - Inspect all areas which have received final cover for deep rooted vegetation, deterioration of vegetative cover, areas of surface erosion and other surface disturbances.
3. Fire Hydrant - Inspect for vandalism.

Attachment 1

HAZARDOUS WASTE
GENERAL INSPECTION SCHEDULE AND CHECKLIST
FORD MOTOR COMPANY - ALLEN PARK CLAY MINE LANDFILL MID980568711

	Date	Time												
	Note	Inspector	Note	Inspector	Note	Inspector	Note	Inspector	Note	Inspector	Note	Inspector	Note	Inspector
ily Items														
roper Disposal														
ate Security														
ccess Road														
arning Signs														
aily Cover														
torm Water														
eachate System														
Bulldozer														
Telephone														
Wee Items														
Fire Extinguishers														
Gauze Masks														
Perimeter Fence														
Surface Drains														
Sediment Basin														
Quarterly Items														
Monitor Wells														
Final Cover														
Fire Hydrant														

( ) Refer to backside for notations and corrections to previous problem areas.
( ) Refer to Spill and Accident Prevention Plan for Procedures.

-over-

F-4 Preventive Procedures, Structures, and Equipment 40 CFR 270.14(b)(8)

F-4a Unloading Operations 40 CFR 270.14(8)(i)

The unloading operation consists of tipping the truck box which requires level ground. The bulldozer operator is responsible for providing a level dump area within the waste management unit.

F-4bc Run-Off/Water Supplies 40 CFR 270.14(b)(8)(ii)(iii)

The topography of the area as shown on the Engineering Drawings (Attachment 14) prevents run-off by collecting any storm waters in the cell excavations as run-on. Contaminated water is not discharged to surface drains but is treated. The area is served by city water provided by Detroit Water and Sewerage Department.

F-4d Equipment and Power Failures 40 CFR 270.14(b)(8)(iv)

A spare pump will be kept at the facility to replace a pump in times of mechanical failure. Heavy equipment and portable generators are also available at the Rouge Complex in case of mechanical or power failure.

F-4e Personnel Protection Equipment 40 CFR 270.14(b)(8)(v)

Operators are not required to wear protective clothing except for safety shoes, due to the relatively innocuous nature of the waste involved. Gauze masks are provided to operators for handling K061 if they do not operate in an enclosed cab.

F-5 Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Wastes 40 CFR 270.14(b)(9)

Ignitable, flammable, reactive, or incompatible wastes are not handled at the facility.

Section G -
Contingency Plan

August 16, 1988

Section G CONTINGENCY PLAN 40 CFR 270.14(b)(7)

G-1 General Information

The hazardous waste disposal facility consists of 16.5 acres in the northeast corner of the site as shown on the site plan. The site address is 17005 Oakwood Boulevard, Allen Park, Michigan 48101, and the site mailing address is Ford Motor Company, and 15201 Century Drive, Suite 608, Dearborn, Michigan 48120.

Waste types to be disposed of at the facility are:

(K061)	Electric Furnace Emission Control Dust
(K087)	Decanter Tank Tar Sludge from Coking Operations
(F006)	Wastewater Treatment Sludge from Electroplating Operations
(D004)	EP Toxic - Arsenic
(D005)	EP Toxic - Barium
(D006)	EP Toxic - Cadmium
(D007)	EP Toxic - Chromium
(D008)	EP Toxic - Lead
(D009)	EP Toxic - Mercury
(D010)	EP Toxic - Selenium
(D011)	EP Toxic - Silver
(001D)	EP Toxic - Copper
(003D)	EP Toxic - Zinc

G-2 Emergency Coordinators (In Priority Order) 40 CFR 264.52 (d)

1. Jerome S. Amber, Primary Emergency Coordinator

Office: (313) 322-4646	Home: (313) 258-6714
Suite 608 CPN	1610 Hanley Court
15201 Century Drive	Birmingham, MI 48009
Dearborn, MI 48120	

Emergency Coordinators - Continued

2. David S. Miller
Office: (313) 322-0700
Suit 608 CPN
15201 Century Drive
Dearborn, MI 48120
Home: (313) 662-4435
3601 Elizabeth
Ann Arbor, MI 48104

3. David A. O'Connor
Office: (313) 322-0701
Suite 608 CPN
15201 Century Drive
Dearborn, MI 48120
Home: (313) 569-7742
18680 Bungalow
Lathrop Village, MI
48076

4. William Dotterrer
Office: (313) 594-1014
Room 108
Construction Services Bldg.
3001 Miller Road
Dearborn, MI 48121
Home: (313) 360-0819
7441 Honeysuckle
West Bloomfield, MI
48033

G-3 Implementation 40 CFR 264.52(d) 40 CFR 264.55

The contingency plan will be implemented by the emergency coordinator when an imminent or actual hazard incident could threaten human health and/or the environment. Example of such hazards could be fire, fumes, dike failure, or storm overflow.

G-4a Emergency Contacts and Notification Procedures 40 CFR 264.56(a)

Any unplanned release of hazardous waste to the soil, air or surface water at the facility which could threaten human health or the environment would warrant implementation of this plan, as well as any condition which if not corrected might cause such a release. The above

emergency coordinator(s) should be contacted if the plan must be implemented, and additional emergency numbers for locally available help are provided as follows:

		Area Code (313)
1.	Ford Plant Security	322-3211
2.	Allen Park Fire Department	928-4100
3.	Allen Park Police Department	386-7800
4.	Wayne County Sheriff	224-2222
5.	Michigan State Police	256-9636
6.	E.M.S. (Taylor)	295-3300
7.	Pollution Emergency Alerting System (D.N.R.)	1-800-292-4706

HOSPITAL EMERGENCY NUMBERS

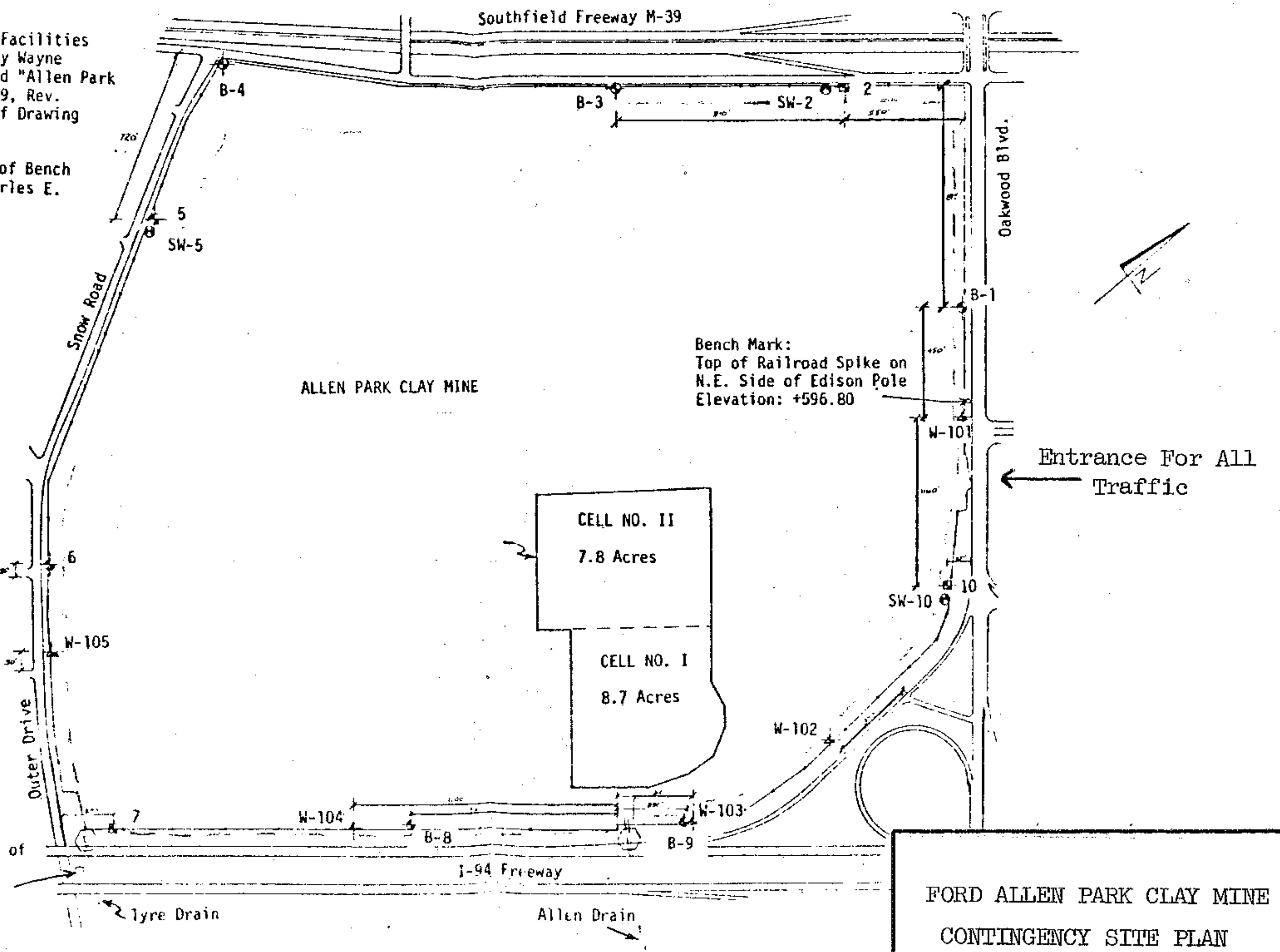
1.	Oakwood Hospital	336-3000
2.	Outer Drive Hospital	386-2000
3.	University of Michigan Hospital - Ann Arbor (Poison Information)	1-764-5120

The person reporting the situation to the emergency coordinator should give the following information:

1. All circumstances known to exist which may effect emergency actions to be taken.
2. Name of person reporting conditions.
3. Location of problem area within the facility.
4. Time of the incident occurring, if known.
5. Type of materials involved, if known.
6. Any injuries to personnel or damage to equipmentif such has occurred.
7. All actions taken, so far, to prevent further harm to human health or the environment.
8. How incident occurred, if known.
9. Request time of arrival for Emergency Coordinator at incident site and any further instructions for actions in the interim.

NOTES:

1. General Layout Of Site Facilities From Drawing Supplied By Wayne Disposal, Inc., Entitled "Allen Park Clay Mine" Dated 9-12-79, Rev. 5-1-81, Sheet No. C-2 of Drawing No. 79P - 23.6.
2. Location And Elevation of Bench Marks Obtained From Charles E. Raines Company


Southfield Freeway M-39
B-4
B-3
SW-2
2
Oakwood Blvd.
5
SW-5
Snow Road
B-1
ALLEN PARK CLAY MINE
W-101
CELL NO. II
7.8 Acres
CELL NO. I
8.7 Acres
6
W-105
SW-10
10
Outer Drive
W-102
7
W-104
B-8
W-103
B-9
I-94 Freeway
Tyre Drain
Allen Drain
N

Bench Mark:
Top of Railroad Spike on
N.E. Side of Edison Pole
Elevation: +596.80

Entrance For All Traffic

Bench Mark
Southwest Corner of Top of
Concrete Lift Station
Building,
Elevation: +591.24

FORD ALLEN PARK CLAY MINE
CONTINGENCY SITE PLAN

G-4b **Identification of Hazardous Materials** 40 CFR 264.56(b)

The emergency coordinator will immediately identify the character, source, extent of the release. The initial identification method will be to utilize visual analysis of the material and location of the release. Any wastes known or suspected to be involved in a release must be sampled (bottles available in manifest trailer).

G-4c-h

Upon receiving a call from facility personnel that an emergency condition exists, the emergency coordinator shall evaluate steps to be taken from the information reported and give instructions as required. The coordinator should then immediately proceed to the site, to conduct the following:

1. Assess extent of emergency.
2. Contact appropriate emergency support agencies if needed.
3. Take precautions to prevent spreading of a spill or fire to other areas.
4. Remove non-employees, and non-essential employees from incident area, particularly during operating hours.
5. Assemble all personnel at trailer for instructions and personnel count. Direct personnel in responding to the incident, if appropriate, or wait for outside emergency personnel and assist in their containment efforts.
6. Prevent additional traffic from entering incident area.
7. Clear road(s) for emergency vehicles and equipment.
8. Contact "hazardous waste checker" if on duty, or check waste inventory log for information on wastes in the incident area to determine potential hazards such as toxic, irritating or asphyxiating gases generated as a result of fire or explosion.
9. In event of fire, consider smoke visibility hazard on I-94 or Southfield Freeways and advise State Police personnel for action.

10. If an evacuation of personnel is appropriate, contact the National Response Center (800-424-8802) and report the following:

    A. Name and phone number of reporter
    B. Name and address of facility
    C. Time and type of incident
    D. Name and quantity of material involved, to the extent known
    E. The extent of injuries if any
    F. Possible hazards to human health, or the environment, outside the facility

11. Immediately after an incident, make assessment to determine the need for disposing of recovered waste, contaminated soil or surface waters or any other material that results from release, fire, or explosion at the facility. (Assume materials are hazardous)

12. The emergency coordinator must ensure that, in the affected area(s) of the facility:

    a. No waste that may be incompatible with the released materials is treated, stored, or disposed of until cleanup procedures are completed.
    b. All emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations are resumed.

13. The owner and operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with applicable requirements before operations are resumed in the affected area(s) of the facility.

4c through 4m not applicable.

G-4n Landfill Leakage 40 CFR 264.52

If liquid is detected in the leak detection system or lysimeter monitoring system, the liquid will be analysed for contamination according to each respective environmental monitoring program. If a statistically significant increase in the concentration of analysed parameters is detected, in accordance with the provisions of the monitoring programs, the following procedure shall be implemented whenever an immediate resampling confirms the statistically significant increase:

a. Notify the Director immediately by calling the Chief of the Waste Management Division, the Waste Management Division District Supervisor, or Department of Natural Resources 24 hour emergency response telephone at 1-800-292-4780, and by providing followup notification to the Chief of Waste Management Division in writing within seven days.

b. Begin immediate action to implement the current contingency plan.

c. Within 30 days, determine the cause of contamination and whether failure has occurred in the liner system.

d. Provide the Chief of the Waste Management Division or his designee, with weekly telephone updates and written reports every two weeks regarding the progress to date in determining the cause of contamination, and the results of all samples from environmental monitoring conducted by the licensee.

G-5 Emergency Equipment and Power Sources 40 CFR 264.52 (e)

Fire Extinguishers	- 8 located throughout the wheel wash building
Telephone	- located at the wheel wash building
Fire Hydrant	- located north of entrance gate
Electrical Power	- outlets located in wheel wash building and air monitoring stations
Misc. Mobil Equipment	- available at the Ford Rouge Plant upon request (front endloaders, vacuum truck, etc.)
Shower	- located in wheel wash building

G-7 Evacuation Procedures 40 CFR 264.52(f)

The facility is an open field whereby specific evacuation routes and emergency aisle space are not required. Personnel are instructed to proceed to the manifest trailer if it is necessary to abandon their work station.

G-8 Required Reports 40 CFR 264.56(j)

The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the contingency plan. Within 15 days after the incident, he must submit a written report on the incident to the U. S. EPA Regional Administrator. The report must include:

a. Name, address, and telephone number of the owner and operator.

b. Name, address, and telephone number of the facility.

c. Date, time, and type of incident (e.g. fire, explosion).

d. Name and quantity of material(s) involved.

e. The extent of injuries, if any.

f. An assessment of actual or potential hazards to human health or the environment, where this is applicable.

g. Estimated quantity and disposition of recovered material that resulted from the incident.

Attachment 19

W
D
I

Wayne Disposal Inc.

P. O. Box 5187
Dearborn, Michigan 48128
(313) 326-0200

November 11, 1981

Allen Park Police Department
16850 Southfield Road
Allen Park, Michigan 48101

RE: Allen Park Clay Mine, 17250 Oakwood Boulevard, Allen Park, Mi.481

Dear Gentlemen/Ms.

In response to Federal requirements under the Resource Conservation and Recovery Act of 1976, all storers, treaters and disposers of hazardous waste must prepare a "Contingency Plan" and emergency procedures for implementation under situations that endanger human health and the environment such as fires, explosions or releases (sudden or non-sudden) of waste into the environment.

It is a requirement that the hazardous waste facility provide copies of the plan to appropriate emergency support agencies and facilities. The hazardous wastes disposed of at the Allen Park Clay Mine are generated at the Ford Rouge Manufacturing Complex, in particular in steelmaking and coking operations. These wastes are not flammable, ignitable, reactive nor corrosive. They pose virtually no threat to human health upon exposure.

Due to the small quantities and nature of these wastes, we believe the possibility of an emergency occurrence to be extremely remote; however, as the law requires we are supplying you with a copy of our plan. If any questions should arise, do not hesitate to call Walt Tomyn or me at 326-0200.

Very truly yours,
Wayne Disposal, Inc.

Mark A. Young

Mark A. Young, P.E.

MAY/kdb

c.c. Allen Park Fire Department
Wayne County Sheriff
Michigan State Police
Lynn Hospital
Outer Drive Hospital'

SHERIFF
WAYNE COUNTY

William Lucas, Wayne County Sheriff, Detroit, Michigan 48226
Loren M. Pittman, Under Sheriff and Chief Deputy
Executive and Jail Division, 224-2222 Court Division, 224-2260 Patrol & Investigation, 561-5880 Metropolitan Airport, WH 1-1200

November 19, 1981

Mark A. Young, P.E.
Wayne Disposal, Inc.
P.O. Box 5187
Dearborn, Michigan 48128

Dear Mr. Young:

The purpose of this communication is to confirm our telephone conversation of November 18, 1981. Our Department is not capable to handle evacuation activities at this time due to a severe manpower shortage.

Yours truly,

Richard M. Novak

Richard M. Novak
Senior Inspector

slh

Address Reply to: William Lucas, Sheriff

PCHA OUTER DRIVE HOSPITAL UNIT OF PEOPLES COMMUNITY HOSPITAL AUTHORI

H. ARTHUR SUGARMAN, *ADMINISTRATOR.* 26400 OUTER DRIVE, LINCOLN PARK, MICHIGAN 48146 (313) 38

EMBER COMMUNITIES

CITIES OF
ALLEN PARK
BELLEVILLE
DEARBORN HEIGHTS
ECORSE
FLAT ROCK
GARDEN CITY
INKSTER
LINCOLN PARK
MELVINDALE
RIVER ROUGE
ROCKWOOD
ROMULUS
SOUTHGATE
TAYLOR
TRENTON
WAYNE
WESTLAND
WOODHAVEN
YPSILANTI

TOWNSHIPS OF
HURON
SUMPTER
SUPERIOR
VAN BUREN
YPSILANTI

November 23, 1981

Mr. Mark A. Young, P.E.
Wayne Disposal, Inc.
P.O. box 5187
Dearborn, MI 48128

RE: Allen Park Clay Mine

Dear Mr. Young:

In regards to your conversation with Mr. Greg Wheeler, Assistant Plant Engineer on November 23, 1981, we are requesting a chemical analysis breakdown of the hazardous material that is disposed of at the Allen Park Clay Mine.

This is to insure that should an accident occur that we at Outer Drive Hospital would have on file a statement as to the contents of the hazardous material for the protection of a possible emergency room case.

Thanking you in advance.

Sincerely,

Mr. Greg Wheeler,
Assistant Plant Engineer

WAYNE DISPOSAL INC
SANITARY LANDFILLS
WDI

Wayne Disposal Inc.

P. O. Box 5187
Dearborn, Michigan 48128
(313) 326-0200

November 24, 1981

Mr. Jack Quillen, Plant Engineer
Outer Drive Hospital
26400 W. Outer Drive
Lincoln Park, Michigan 48146

Dear Mr. Quillen:

Per your request, here are chemical analyses of the two hazardous wastes landfilled at the Allen Park Clay Mine. We hope this information will be satisfactory. Should questions arise, give me a call.

Very truly yours,
Wayne Disposal, Inc.

Mark A. Young

Mark A. Young, P.E.

MAY/kdb
Enclosures

Electric Furnace Flue Dust (K061)

A. Sample Taken:
Lab No. 004680

1. E.P. Toxicity per U.S. EPA SW-846, 1980

Element	Results, ppm	Method of Analysis
Arsenic	0.6	EPA 600/4-79-020
Barium	< 0.8	"
Cadmium	45.0	"
Chromium	1.6	"
Lead	340	"
Mercury	0.0015	Perkin-Elmer 303-3119
Selenium	2.0	I.C.P.
Silver	0.8	EPA 600/4-79-020

2. Chemical Analysis of Electric Furnace Flue Dust

Element	Results (mg/kg)	Method of Analysis
Arsenic	50	ASTM E 663
Barium	< 0.8	"
Cadmium	95.0	"
Chromium	500	"
Lead	4,500	"
Mercury	< 0.3	I.C.P.
Selenium	2.0	I.C.P.
Silver	6.0	ASTM E 663
Manganese	39,000	"
Zinc	150,000	"
Phosphorus	450	Molybate
Sulfur	3,600	1r 32-Leco
Calcium	61,000	ASTM E 663
Magnesium	11,000	"
Aluminum	2,400	"
Silicon	15,000	Na_2CO_3 Fusion
Potassium	5,900	ASTM E 663
Sodium	5,200	"
Fluorine	26.2	Ion Chromatograph
Total Iron	350,000	ASTM E 663
Dissolved Iron	800	"
Cyanide	0.1	EPA 79, M3352
Phenol	0.960	EPA 79, M420.1
Carbon	4,700	Leco Wr-12

Coke Oven Tar Decanter Sludge (K087)

A. Sample Taken: 8-28-80
Lab No. 005092

1. E.P. Toxicity per U.S. EPA SW-846, 1980

Element	Results, ppm	Method of Analysis
Arsenic	< 0.1	EPA 600/4-79-020
Barium	< 0.8	"
Cadmium	< 0.005	"
Chromium	< 0.1	"
Lead	0.2	"
Mercury	0.0001	Perkin-Elmer 303-3119
Selenium	< 0.25	EPA 600/4-79-020
Silver	< 0.1	"

2. Ignitability per U.S. EPA SW-846, 1980, Section 4.0

Flash Point ASTM D 93	> 60°C

3. Reactivity per U.S. EPA SW-846, 1980, Section 6.0

Total Cyanide EPA 79, M3352	10.65 ppm

RICHARD A. HUEBLER
CITY ADMINISTRATOR

City of Allen Park
OFFICE OF ADMINISTRATOR
16850 SOUTHFIELD ROAD
ALLEN PARK, MICHIGAN 48101
PHONE: 928-1400

June 17, 1987

Mr. Douglas A. Painter, Manager
Ford Motor Company Mining Department
3001 Miller Road
Dearborn, Michigan 48121

Re: "Contingency (Emergency) Plan"
Ford Motor Mine

Dear Mr. Painter:

I wish to thank you for your plan. It will become part of the City Plan for Emergency Management.

For your information:

Emergency Management Coordinator is
Richard A. Huebler (City Administrator)
16850 Southfield Road, Allen Park, MI 48101
Phone: 928-1400

Deputy Emergency Management Coordinator is
Carson C. Smith (Administrative Assistant)
Address and phone number above

Environmental Inspector
Ardys Bennett (Building Inspector)
Address and phone number above

Hazardous Material Response
Raymond Bertoncelli (Fire Chief)
6730 Roosevelt, Allen Park, MI 48101
Phone: 928-0024

Copies of your plan have been issued to the concerned parties.

Respectfully,

Richard A. Huebler vag

Richard A. Huebler
City Administrator

RAH:vag

Section H -
Training

Job Descriptions
H-la Job Titles/Job Descriptions 40 CFR 264.14(d)(1)

Hazardous Waste Shipment and Manifest Checker - Requisite qualifications are good judgement, common sense and good communication skills.

1. Inspection of hazardous waste shipments.
   a. Identify hazardous wastes visually by comparison with on-site sample (visual and/or smell).
   b. Verify volume of shipment visually with no more than 10% error (volume basis).
2. Direct transporter to dump hazardous wastes in designated area.
3. Sign valid manifests and retain necessary copies.
4. Record shipment information with disposal location cross-reference.
5. Deliver transporter to dump hazardous wastes in designated area.
6. When manifest discrepancies occur:
   a. Contact generator for explanation.

   b. Refuse permission to dispose of shipment if explanation in a. is not sufficient.
7. Keep disposal map locator up to date.
8. Make required inspections under the general inspection procedure.
9. Review aspects of facility inspections.
10. Activate when conditions warrant the Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures.

Operating Engineer - Requisite qualifications are good judgement, common sense, experience on heavy machinery operation and maintenance.

1. Maintain equipment (Tracked Dozer) in good working order.
2. Notify management of equipment problems.
3. Keep fill site graded and covered with inert material as conditions warrant.
4. Maintain area in neat and orderly appearance.
5. Assist manifest checker in observations required by the general inspection procedure.
6. Verify identity and volume of waste before burial.
7. Implement safety procedures.
8. Implement procedures for using, inspecting, repairing and replacing emergency and safety equipment.

Foreman - Requisite qualifications are good judgement and common sense, experience on heavy machinery operation and maintenance.

1. Responsible for day-to-day supervision of construction and maintenance personnel.
2. Make required site inspections.
3. Knowledge of the Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures.
4. Knowledge and implementation of safety procedures.
5. Functions as emergency coordinator in absence of Ford Motor Company officials.

Inspectors Responsibility - Requires good judgement, common sense and good communication skills.

1. Perform inspections as needed, in addition to a daily and weekly schedule.
2. Maintain the leachate sampling device. Maintain the leachate collection system.
3. Report to Ford representatives the status of facility operations.
4. Provide corrdination for facility activities.
5. Knowledge of the Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures.

H-1b Training Content Frequency, and Techniques 40CFR 264.16(c)

Ford Training Program

Employees will be assembled every 12 months to review pertinent aspects of their job.

Hazardous Waste Shipment and Manifest Checker - Receives introductory on-the-job training.

1. Physical properties and characteristics of the wastes are discussed in detail.
2. Inspection and waste verification procedures are practiced in order to verify waste identity and volume.
3. Processing the manifest form is discussed including manifest discrepancies.
4. Recordkeeping procedures are discussed.
5. General inspection procedures are discussed.
6. Pertinent waste handling and disposal regulations are discussed.
7. The Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures are discussed.
8. Safety procedures are discussed.

Operating Engineer - Receives introductory on-the-job training.

1. Physical properties and characteristics of the wastes are discussed in detail.
2. Inspection and waste verification procedures are discussed in order to verify waste identity.
3. General inspection items and procedures are discussed.
4. Pertinent waste handling and disposal regulations are discussed.
5. The Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures are discussed.
6. Fill and grading plan are discussed.
7. Safety procedures and procedures for using, inspecting, repairing and replacing emergency safety and monitoring equipment are discussed.

Foreman - Receives introductory on-the-job training.

1. Physical properties and characteristics of the wastes are discussed in detail.
2. Processing the manifest form is discussed including manifest discrepancies.
3. General inspection procedures are discussed and practiced.
4. Pertinent waste handling and disposal regulations are discussed.
5. The Spill Plan and Accident Prevention Plan, Contingency Plan and Emergency Procedures are discussed.
6. Safety procedures and procedures for using inspecting, repairing and replacing emergency, safety and monitoring are discussed.
7. Fill and grade plans are discussed.

Inspectors Responsibility - Requires good judgement, common sense and good communication skills.

1. Perform inspections as needed, in addition to a daily and weekly schedule.
2. Maintain the leachate sampling device. Maintain the leachate collection system.
3. Report to Ford representatives the status of facility operations.
4. Provide coordination for facility activities.
5. Knowledge of the Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures.

Michigan Hazardous Waste Industry

Training and Technical Assistance Program

An example of the training provided by the independent waste management concerns is provided as Attachment 20.

A recorded schedule of trained employees is provided as Attachment 21.

Attachment 20

HAZARDOUS WASTE HANDLER'S TRAINING COURSES

Michigan Hazardous Waste Industry Training and Technical Assistance Program

Michigan State University, Community Development Programs
27 Kellogg Center
East Lansing, MI 48824

In cooperation with the Liquid Industrial Control Association

Supported by a grant from the Michigan Deparment of Labor
Safety Education and Training Program

Michigan Hazardous
Waste Industry
Training and Technical
Assistance Program

Community
Development
Programs
Michigan State University
27 Kellogg Center
East Lansing, MI 48824
(517) 355-0100

199 Pierce Street
Birmingham, MI 48011
(313) 642-9797

April 13, 1983

To: Members, Act 64 Advisory Committee

From: Lynn A. Corson, Ph.D. LAC

Subject: Conveyance of Material Re: Michigan Hazardous Waste Industry Training and Technical Assistance Program

It is with pleasure that I respond to the request of one of your members, Mr. Walter Pociask, K & D Industrial Services, and provide the attached information.

The Curriculum Guide provides a general outline of the various courses offered to employees of firms licensed as processors or haulers of hazardous waste under Act 64 and transporters of liquid industrial waste licensed under Act 136.

The brochure describes the training and technical assistance program in more detail.

I will be pleased to answer any questions that the Committee or its individual members may have regarding the program.

005 Overview: Safety Hazards of Working with Hazardous Wastes
Instructional Outline

Topics

1. Physical Properties of Chemicals
   a. Physical states: solid, liquid, gas, vapor
   b. Organics and inorganics - solvents, etc.
   c. Acids and bases - pH

2. Incompatible chemicals - problems with mixing
   a. Release of noxious gases: e.g., cyanide, H_2S
   b. Relese of heat - concentrated acids and bases
   c. Other examples - MDOL/SET list

3. Storage and labeling - applies to all containers - large or small
   a. Proper identification of contents - keep in original container whenever possible
   b. Store in proper area: e.g., flammables, incompatibles, corrosives
   c. Other considerations - don't stack too high to present handling difficulty; leakage problems; aisles between; containment provisions

4. Materials handling -
   a. Housekeeping
   b. Proper lifting techniques
   c. Drum handling
   d. Lift trucks
   e. MDOL/SET "5 minute safety talks"

5. Controls - Engineering controls and Personal Protective Equipment
   a. Hazards Recognition
      1) Falling
      2) Striking
      3) Being caught
      4) Contact injuries
      5) Breathing in harmful atmospheres
   b. Other - machine guarding, blind corners, barricade, construction

6. Fire Safety
   a. Prevention - housekeeping; call list; disaster plan
   b. Theory - fire triangle; flash point; L.E.L.; U.E.L.; extinquishment principles
   c. Equipment - blanket; extinquisher use - CO, CO_2, dry chemical

7. Confined Space Entry - Definition
   a. Legal - MIOSHA rules
   b. Hazards awareness - CO, CO_2, toxic gases, flammables
   c. Atmosphere testing - $\%O_2$ and L.E.L.; meters; toxic gas sampling; ventilation area
   d. Victim rescue and equipment for safe entry

8. First Aid - Immediate action -
   a. Prevention and Readiness - first aid rules and kits
   b. Procedures - immediate flushing, call list
   c. Equipment - drenching showers, eye washes
   d. Chronic - dermatitis prevention

Resources

1. Handout - Employee Safe Work Manual - Dray Publishing Co.
2. Chart - Flammable liquid chart

Physic tates of Matter

Matter can exist in three different states, designated as solid, liquid, and gas (Fig. 1-1), which can be distinguished by certain qualities.

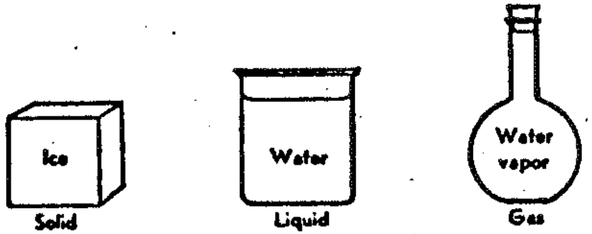


Fig. 1-1 The physical states of matter as illustrated by water.

A good example of these three states of matter is furnished by a block of ice. As ice it is a solid, the shape of which can be changed by moderate force, but its volume can be changed only by a very great force; i.e., ice is only very slightly compressible. If its temperature is raised it melts, that is, it passes into the liquid state as water. Its shape then will depend on the vessel it is in, or if spilled on the ground it will flow into whatever cavities and spaces there are between the particles that make up the soil. As water, its volume can be changed very little because, like ice, it is nearly incompressible. Heated to boiling in an open vessel, it changes to a gas or vapor and will expand and disappear completely in the air. Heated in a closed vessel, the vapor is retained in the form of steam, causing pressure on the sides of the vessel.

This expansion due to the change from the liquid to the gaseous state by heating is extremely important. Without it there would be no steam engines or steam power plants. This has its bad side too, for it causes boiler explosions and furnishes most of the explosive force of volcanoes.

Few substances can change as readily under normal conditions into the three states of matter as water. But the safety man should recognize that change in the state of matter, as from solid to liquid to gaseous, occurs in many chemical processes. The degree of expansion when changing from one state to another (liquid to gas) has marked safety implications.

Vapor

The term vapor is applied to the gaseous form of substances that at ordinary temperature can exist both as a gas and as either a liquid or a solid. For example, gasoline, normally a liquid, vaporizes to produce a gas which when mixed with the correct amount of air makes our automobiles run. Water at all ordinary temperatures evaporates to form a gas which we ordinarily refer to as water vapor. Vapors are often a nuisance, a byproduct of the use of the liquid or solid producing them. They are also used to do work, such as vapor degreasing. Many vapors are toxic, for example, the vapor of carbon tet loride; and the safety man should be on guard whenever vapors are encountered.

Dust

For all practical purposes we can define dusts as particles of solid matter divided by abrasion and fine enough to float along and to be distributed by ordinary air motion. This, of course, means bad air for breathing and if the dust is combustible a fire and explosion hazard as well.

Fume

Fumes are particles of solid matter also, but the term fume is correct only for particles formed when vapors are condensed from heating metals or other substances.

Mist

Mists are droplets of liquid so fine that they float in the air. They may be formed by condensation from the gaseous form (example, fog above a pond on a still cold morning), by gas escaping from a liquid and carrying fine droplets with it (example, chromium plating tank), or by breaking a liquid up into a very fine spray (example, air brushing).

Chemical and Physical Changes

When carbon, a black solid substance, burns in air, an invisible gas consisting of both carbon and oxygen (carbon dioxide) is formed. When milk sours, the sugar in the milk is converted into an acid, and the composition and the properties of the acid differ greatly from those of the sugar. Iron rust formed by the corrosion of iron metal contains oxygen as well as iron, and it is therefore a different substance with different properties. All such changes are called chemical changes. A chemical change always produces at least one substance entirely different in composition and properties from those that existed before the change occurred. In addition, all chemical changes are accompanied by either the formation or absorption of some form of energy.

Changes that do not alter the composition of a substance are known as physical changes. The melting of ice, the freezing of water, the conversion of water to steam, the condensation of steam to water, the dissolving of sugar in water, and the heating of iron to redness, are all examples of physical change. In each of these there is a change in properties but there is no alteration of the chemical composition of the substances involved. Water, whether in the solid, liquid, or gaseous state, retains the same chemical composition. Sugar is the same chemical substance in solution in water as it is in the solid state and can readily be recovered as crystals by evaporation of the water. Iron, an emitter of light when red hot, is still the same substance that reflects light when cold.

Skin Absorption

The intact skin (see Fig. 17-1) is an excellent barrier to passage of most chemicals, especially against most water solutions. However, many chemicals will be absorbed through the skin, while others, which will not be absorbed through the intact skin, may enter the body through cuts, blisters, or wounds. Absorption this way may be more dangerous than through the respiratory or digestive system, which may provide defensive mechanisms, since it is absorbed directly into the bloodstream. Chemicals that will be absorbed even through an intact skin include tetraethyl lead, used as a knock suppressant in high-octane gasoline, aniline, hydrazine, the boranes, and nitroglycerine.

Corrosives

Corrosives damage by chemical reaction with the skin they contact. In addition to injuring the skin and the underlying tissues, the wound provides a point of entry for the toxicant to reach the bloodstream, producing an effect worse than skin damage.

Corrosive burns can be caused by strong acids or alkalies. Alkalies can cause progressive burns, the injury increasing as the alkali moves through damaged tissue. This is especially critical in injuries to the eye, where delicate tissues can be damaged little by little until vision is destroyed. If a corrosive chemical is swallowed, it will cause pain in the mouth, throat, and stomach. There will usually be vomiting, difficulty in swallowing and breathing, distension and pain caused by gas in the stomach.

Some common corrosives are concentrated acids, such as nitric, hydrochloric, sulfuric, and oxalic; strong alkalies, such as sodium or potassium hydroxide; and reactive elements, such as iodine, chlorine, or fluorine.

The severity of a corrosive burn depends on the concentration and type of corrosive chemical, whether the contact was covered or uncovered, and the length of time of contact. For this reason, a harmful agent should be washed away as soon as possible and neutralized with a mild antidote if one is available.

A covered skin contact usually creates a severer skin reaction than one which is uncovered. Tricresyl phosphate evaporates rapidly from an uncovered skin, with a sensation of coldness and a brief mild redness. Clothing wet with tricresyl phosphate produces a burning sensation and blisters like those of a second-degree burn. Even less harmful liquids, such as gasoline, will produce similar reactions. The importance of prompt removal of contaminated clothing and of damaging chemicals is apparent.

Dermatitis

Dermatitis is skin inflammation caused by defatting of the skin or by contact with an irritating or sensitizing substance. Exposure to solvents often causes removal of the oils that keep the skin soft and pliable, making it dry, scaly, somewhat thickened, and with a tendency to crack easily. Some redness may result from the irritating effects created by the absence of fats. Such skins often have poor resistance to bacterial infection and heal slowly when injured. Replacement of oils with creams and lotions to control the condition is only partly effective. The only hope of recovery is generally removal from further

Of all skin contacts, those with the eyes are the most damaging, because of their sensitivity. Most materials have the ability to injure the eye to some degree. Solids can harm by abrasion or by chemical action. The mildest injury is probably irritation which causes redness, watering, and stinging. More severe irritation can damage the cornea, the transparent covering of the eye, involving a dry scratching feeling and various levels of pain.

A corneal burn is the commonest chemical eye injury. Corrosive vapors or fine spray can cause many tiny burn spots. Contact with a strong mineral acid or alkali can damage or destroy vision. The tendency of alkali burns to spread, even though emergency treatment has been given, makes them particularly troublesome.

A hazard that has developed in the past few years is the possibility that a sprayed or splashed corrosive material, either vapor or fine liquid, may be caught between a contact lens and the eye. This keeps the chemical in close contact with the eye for an abnormally long period, aggravating the burn.

Solvents

The solvents we are interested in are those that are hazardous. Some give off vapors that will burn and explode; for example, gasoline, naphtha, benzene, methanol (wood alcohol). Some are extremely toxic and their vapors, if breathed, can poison one; examples, benzene, carbon tetrachloride, methanol. Note that benzene and methanol present both hazards.

Carbon tetrachloride formerly was used in fire extinguishers. Its high toxicity, however, makes it unsafe in many situations, and many authorities now prohibit its further use as a fire extinguishing agent.

Another point to remember is that the higher the temperature the faster the vapors come off from the liquid. So if the process in which the solvent is used heats it up, the hazard is increased. The amount (concentration of vapor in the air) reaches the point at which it can burn or explode, or at which it can poison one more quickly than if it were not heated. That might make it seem that the hazard is greater in hot weather than cold, but this may be offset by the fact that windows and doors are likely to be kept open in summer and kept tightly closed in winter, at least wherever winters are cold.

Chemical Symbols

The chemical symbols are so universally used to indicate the chemical compounds that every safety man should know the symbols of at least the common elements. These symbols make possible a simple means of indicating the makeup (chemical formula) of each compound. For example, the formula for carbon monoxide is CO, which shows that each molecule of carbon monoxide is made up of one atom each of carbon and oxygen. Where there is more than one atom of an element in a compound a subscript is used to show it. For example, carbon dioxide is CO_2, meaning that one carbon and two oxygen atoms have combined. Water is H_2O. By adding another atom of oxygen to H_2O we get hydrogen peroxide H_2O_2, a mild solution which has long been used by women to change their brown tresses to blond. When concentrated it is a dangerously corrosive chemical. What a difference that extra little atom of oxygen makes!

We need not concern ourselves with the highly complex compounds of organic chemistry. Even the chemist uses the name if the formula is long. If it has a short trade name he will probably use that. For example, the formula for the widely used insecticide DDT is $(ClC_6H_4)_2\ CHCCl_3$. Its chemical name is dichloro-diphenyl-trichloroethane. No one will ever expect anyone but a chemist to know its chemical name let alone its chemical formula. But a safety man should recognize the formula, as well as the name, for many of the chemical compounds he will encounter. Here are a few to start with.

Inorganic Compounds

Sulfuric acid—H_2SO_4
Nitric acid—HNO_3
Hydrochloric acid—HCl
Ammonia—NH_3
Caustic soda (lye)—$NaOH$
Caustic potash—KOH

Organic Compounds

Carbon tetrachloride—CCl_4
Ethyl alcohol (grain alcohol)—C_2H_5OH
Benzene (benzol)—C_6H_6
Toluene—$CH_3C_6H_5$
Methyl alcohol (methanol)—CH_3OH

Acids, Bases, and Salts

Acids. Acids are compounds that have one or more atoms of loosely held hydrogen. This hydrogen acts as though it were dissatisfied with its partner and is always looking for one it likes better, for example, hydrochloric acid (HCl). The hydrogen atom is so dissatisfied that it will take up with almost anything. Of course, the other partner, chlorine, is not too happy either. For example, when a molecule of HCl meets up with a molecule of ordinary lye ($NaOH$), they swap partners fast and get hot in doing so. The reaction is $HCl + NaOH = NaCl + H_2O +$ heat. The reaction goes fast and is likely to form steam and cause spattering or explosion.

Three acids are found in every laboratory and many plants, and are so essential that they have been referred to as the workhorses of the chemical industry. They are made and used in amounts of millions of tons per year. These acids are hydrochloric (HCl), sulfuric (H_2SO_4), and nitric (HNO_3). Because of their dissatisfied hydrogen element, they are very active chemically, they attack a very wide variety of substances including human skin and flesh and eyes. They are not flammable, that is they do not burn or explode. There is, however, the ever present possibility of leakage or spillage into materials or substances with which they can react to cause fire or explosion or liberate toxic vapors or gases. Nitric acid in particular is likely to set fire to sawdust, shavings, straw, and many other finely divided combustible materials. Both hydrochloric and nitric acids give off gas when heated and, therefore, can burst their containers. The vapors given off by nitric acid when it is heated are very dangerous when breathed in any considerable amount, they are likely to cause fatal lung damage. The vapors of HCl and H_2SO_4 are so intensely irritating that they are unbreathable. This property is a safeguard because it gives warning of even very low concentration in the air of the workroom. One gets out quickly, if he can, to get his breath and get the sting out of his eyes. If the concentration is high and he can't get out, he dies.

Acids should be stored in cool places away from the sun and away from other chemicals and waste materials. The possibility leakage to floors below (if any) should always be taken into accou Where amounts kept are considerable, floors should be impervious, acid resisting material, and arranged to be hosed down as needed.

Provisions should be made for the safe handling of contai , p ticularly carboys. Various types of carboy handling equipme (t ers, carriers) are available commercially.

Protective clothing—rubber aprons, gloves, and perhaps acid res ing shoes—should be worn when handling acids. Chemical t goggles or face shields should always be worn when handling or us acids of any kind.

NOTE. Bulletin 265, "The Inorganic Acids," of the U.S. Department of La Bureau of Labor Standards, contains detailed information on the poten hazards connected with the use and handling of acids and recommended cedures for control measures.

Bases. Bases are compounds that have one or more "hydrox groups. A hydroxyl group is an atom of oxygen linked to an at of hydrogen (OH). Chemically, it acts much as though it we single atom.

We have two very active bases that are widely used: caustic s (sodium hydroxide) ($NaOH$) and caustic potash (potassium droxide) (KOH). Their hazards are similar and we treat them al They are called "caustics" because they eat most organic substanc skin, fat, flesh, hair, your shoes, the wooden floor. They react fats to form soap and glycerine. Ordinary lye is $NaOH$ dissol in water.

These two caustics are marketed and handled in the form of lu pellets, sticks, and in cans or drums of light gage sheet steel. molten caustic is poured into a drum. It hardens on cooling white solid mass. The user strips the sheet metal off and chops or breaks up the caustic into pieces of convenient size. This invo the hazard of flying chips that will stick to sweaty skin and b Caustics can cause very serious eye damage. Suitable equipment—aprons, gloves, goggles or face shields—must be w when handling or using caustics. Also, safety should be provi for other nearby workmen.

Calcium (Ca) gives us another widely used base that, while as caustic as caustic potash or caustic soda, offers hazards. Ordin limestone is calcium carbonate ($CaCO_3$). When burned in a it gives off CO_2 and becomes quicklime (CaO). If water is ad to CaO it swells up, gets hot, and becomes $Ca(OH)_2$ (caustic lin that is, $CaO + H_2O = Ca(OH)_2$. It will then take CO_2 out of air, turn the H_2O loose and again becomes $CaCO_3$. This is the react by which lime plaster and lime mortar harden.

CaO and $Ca(OH)_2$ are both caustic but are much less so than Na and KOH. The fact that quicklime heats up on wetting has ca many fires, particularly in building supply yards. Quicklim dumped into a wooden bin, the roof leaks, fire starts in the bin is carried to the nearby lumber. Another lumber yard goes Such fires are spectacular and very expensive, all because of fai to store quicklime properly. Quicklime should be stored in conc bins with leak-proof metal covers, preferably hinged so that won't be left off or thrown back. Then make doubly sure by havi good roof.

Salts. A salt is a compound, other than water, which is formed the reaction of an acid with a base. Salts are mostly stable, e tempered compounds well satisfied with their lot in life. Some them, however (the offspring of the "per" acids, perchloric example), are very touchy and blow up on very slight provocat The salts of nitric acid (nitrates) are for the most part fairly sta but if heated with oxygen-hungry substances they may give up t oxygen and set their nitrogen free without much fuss, or they start a fire or give off poisonous gases or both. So don't fool nitrates unless you know them. The same is true of perchlor and the like, only more so.

B. DOT HAZARD CLASS

Enter the two digit code from the table below which corresponds to the DOT hazard class of the waste described. If the waste described has been shipped under more than one DOT hazard class, use a separate line for each DOT hazard class.

DOT HAZARD CLASS	Code
Combustible	.01
Corrosive	.02
Etiologic agent	.03
Explosive A	.04
Explosive B	.05
Explosive C	.06
Flammable gas	.07
Flammable liquid	.08
Flammable solid	.09
Irritating agent	.10
Nonflammable gas	.11
Organic peroxide	.12
O -A	.13
OR B	.14
ORM-E	.15
Oxidizer	.16
Poison A	.17
Poison B	.18
Radioactive	.19

TABLE OF HAZARD CLASS PRIORITIES

most

- Poison A
- Flammable Gas
- Flammable Liquid
- Oxidizer
- Flammable Solid
- Corrosive Material, Liquid
- Poison B
- Corrosive Material, Solid
- Irritating Materials
- Combustible Liquids
- Other Regulated Materials (ORM) E
- Other Regulated Materials (ORM) B
- Other Regulated Materials (ORM) A

least

DEGREE OF HAZARD

C. EPA HAZARDOUS WASTE NUMBER

For listed wastes, enter the four digit EPA Hazardous Waste Number from 40 CFR Part 261, Subpart D (see Appendix) which identifies the waste. For unlisted wastes which exhibit hazardous characteristics, enter the four digit EPA Hazardous Waste Number from 40 CFR Part 261, Subpart C (see Appendix) which is applicable to the waste.

For a mixture of more than one listed or unlisted waste, enter all of the relevant EPA Hazardous Waste Numbers. Four spaces are provided for this on each waste line. If more space is needed, continue on the next line(s), and leave all other items on that line blank, as shown by the example below. Generators who ship lab packs are currently required to list the hazardous waste number for each of the constituents of the pack.

5.2 *Waste Characteristics.* The hazardous substance that was observed for scoring the release category may be different from the substance used to score waste characteristics.

Reactivity and incompatibility, measures of the potential for sudden releases of concentrated air pollutants, are evaluated independently, and the highest value for either is recorded on the work sheet.

Reactivity provides a measure of the fire/explosion threat at a facility. Assign a value based on the reactivity classification used by NFPA (see Table 11). Reactivity ratings for a number of common compounds are given in Table 4.

TABLE 11.—NFPA REACTIVITY RATINGS

NFPA level	Assigned value
0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water	0
1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently	1
2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water	2
3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which requires a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement	3
4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock	4

TABLE 12.—INCOMPATIBLE MATERIALS

In the lists below, the mixing of a Group A material with a Group B material may have the potential consequence as noted.

Group 1-A	Group 1-B
Acetylene sludge	Acid sludge.
Alkaline caustic liquids	Acid and water.
Alkaline cleaner	Battery acid.
Alkaline corrosive liquids	Chemical cleaners.
Alkaline corrosive battery fluid.	Electrolyte acid.
Caustic wastewater	Etching acid liquid or solvent.
Lime sludge and other corrosive alkalies.	Pickling liquor and other corrosive acids.
Lime wastewater	Spent acid.
Lime and water	Spent mixed acid.
Spent caustic	Spent sulfuric acid.
Potential consequences: Heat generation, violent reaction.	
Group 2-A	**Group 2-B**
Aluminum	Any waste in Group 1-A or 1-B.
Beryllium	
Calcium	
Lithium	
Potassium	
Sodium	
Zinc powder	
Other reactive metals and metal hydrides.	
Potential consequences: Fire or explosion, generation of flammable hydrogen gas.	
Group 3-A	**Group 3-B**
Alcohols	Any concentrated waste in Groups 1-A or 1-B.
Water	Calcium. Lithium. Metal hydrides. Potassium. SO_2Cl_2, $SOCl_2$, PCl_3, CH_3SiCl_3. Other water-reactive waste.
Potential consequences: Fire, explosion, or heat generation, generation of flammable or toxic gases.	
Group 4-A	**Group 4-B**
Alcohols	Concentrated Group 1-A or 1-B wastes.
Aldehydes	Group 2-A wastes.
Halogenated hydrocarbons	
Nitrated hydrocarbons	
Unsaturated hydrocarbons	
Other reactive organic compounds and solvents.	
Potential consequences: Fire, explosion, or violent reaction.	
Group 5-A	**Group 5-B**
Spent cyanide and sulfide solutions.	Group 1-B wastes.
Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.	
Group 6-A	**Group 6-B**
Chlorates	Acetic acid and other organic acids.
Chlorine	Concentrated mineral acids.
Chlorites	Group 2-A wastes.
Chromic acid	Group 4-A wastes.
Hyphochlorites	Other flammable and combustible wastes.
Nitrates	
Nitric acid, fuming	
Perchlorates	
Permanganates	
Peroxides	
Other strong oxidizers	
Potential consequences: Fire, explosion, or violent reaction.	

Source: Hazardous Waste Management Law, Regulations, and Guidelines for the Handling of Hazardous Waste. California Department of Health, Sacramento, California, February 1975.

Incompatibility provides a measure of the increased hazard when hazardous substances are mixed under uncontrolled conditions, leading to production of heat, pressure, fire, explosion, violent reaction, toxic dusts, mists, fumes or gases, or flammable fumes or gases. Table 12 provides examples of incompatible combinations of materials.

7.0 Fire and Explosion

Compute a score for the fire and explosion hazard mode, S_{FE}, when either a state or local fire marshal has certified that the facility presents a significant fire or explosion threat to the public or to sensitive environments or there is a demonstrated fire and explosion threat based on field observations (e.g., combustible gas indicator readings). Document the threat.

7.1 *Containment. Containment* is an indicator of the measures that have been taken to minimize or prevent hazardous substances at the facility from catching fire or exploding. Normally it will be given a value of 3 on the work sheet (Figure 11). If no hazardous substances that are individually ignitable or explosive are present and those that may be hazardous in combination are segregated and isolated so that they cannot come together to form incompatible mixtures, assign this factor a value of 1.

7.2 *Waste Characteristics. Direct evidence* of ignitability or explosion potential may exist in the form of measurements with appropriate instruments. If so, assign this factor a value of 3; if not, assign a value of 0.

Additional information can be obtained from *A Method for Determining the Compatibility of Hazardous Wastes,* H. K. Hatayama, *et al.,* EPA-600/2-80-076 (1980). Assign a value using the following guidance:

Incompatibility	Assigned value
No incompatible substances are present	0
Present but do not pose a hazard	1
Present and may pose a future hazard	2
Present and posing an immediate hazard	3

Toxicity should be rated for the most toxic of the substances that can reasonably be expected to be transported away from the facility via the air route. Using the information given in Tables 4, 6, and 7, assign values as follows:

Toxicity	Assigned value
Sax level 0 or NFPA level 0	0
Sax level 1 or NFPA level 1	1
Sax level 2 or NFPA level 2	2
Sax level 3 or NFPA levels 3 or 4	3

PARTIAL LIST OF INCOMPATIBLE CHEMICALS *

Substances in the right-hand column should be stored and handled so they cannot possibly contact corresponding substances in the left-hand column.

Alkaline and alkaline earth metals, such as sodium, potassium, cesium, lithium, magnesium, calcium, aluminum	Carbon dioxide, carbon tetrachloride, and other chlorinated hydrocarbons. (Also prohibit water, foam, and dry chemical on fires involving these metals.)
Acetic acid	Chromic acid, nitric acid, hydroxyl containing compoun ethylene glycol, perchloric acid, peroxides, and permaga
Acetone	Concentrated nitric and sulfuric acid mixtures.
Acetylene	Chlorine, bromine, copper, silver, fluorine, and mercury.
Ammonia (anhyd.)	Mercury, chlorine, calcium hypochlorite, iodine, bromid and hydrogen flouride.
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitri sulfur, finely divided organics or combustibles.
Aniline	Nitric acid, hydrogen peroxide.
Bromine	Ammonium, acetylene, butadiene, butane and other petroleum gases, sodium carbide, turpentine, benzene, and finely divided metals.
Calcium carbide	Water (see also acetylene).
Calcium oxide	Water.
Carbon, activated	Calcium hypochlorite.
Copper	Acetylene, hydrogen peroxide.
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organics or combustibles.
Chromic acid	Acetic acid, naphthalene, camphor, glycerine, turpentine, alcohol, and other flammable liquids.
Chlorine	Ammonia, acetylene, butadiene, butane and other petrol gases, hydrogen, sodium carbide, turpentine, benzene, an finely divided metals.
Chlorine dioxide	Ammonia, methane, phosphine, and hydrogen sulfide.
Fluorine	Isolate from everything.
Hydrocyanic acid	Nitric acid, alkalies.
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane, caustic soda and other strong alkalies.
Hydrofluoric acid, anhyd. (Hydrogen fluoride)	Ammonia, aqueous or anhydrous.
Hydrogen sulfide	Fuming nitric acid, oxidizing gases.
Hydrocarbons (benzene, butane, propane, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide.
Iodine	Acetylene, ammonia (anhyd. or aqueous).

- over -

Mercury	Acetylene, fulminic acid, ammonia.
itric acid (conc.)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, and nitritable substances.
Nitroparaffins	Inorganic bases.
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases.
Oxalic acid	Silver, Mercury.
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils.
Peroxides, organic	Acids (organic or mineral); avoid friction.
Phosphorus (white)	Air, oxygen.
Potassium Chlorate	Acids (see also chlorate).
Potassium perchlorates	Acids (see also perchloric acid).
Potassium permanganate	Glycerine, ethylene glycol, benzaldehyde, sulfuric acid,
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compou
Sodium	See alkaline metals (above).
dium nitrate	Ammonium nitrate and other ammonium salts.
Sodium oxide	Water.
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, and furfural.
Sulfuric acid	Chlorates, perchlorates, permanganates.
Zirconium	Prohibit water, carbon tetrachloride foam, and dry chemical on zirconium fires.

* Based on Dangerous Chemicals Code, 1951 Edition, pp. 19-20, Bureau of Fire Prevention, City of Los Angeles, Fire Department, published by Parker & Company, Los Angeles 13, California.

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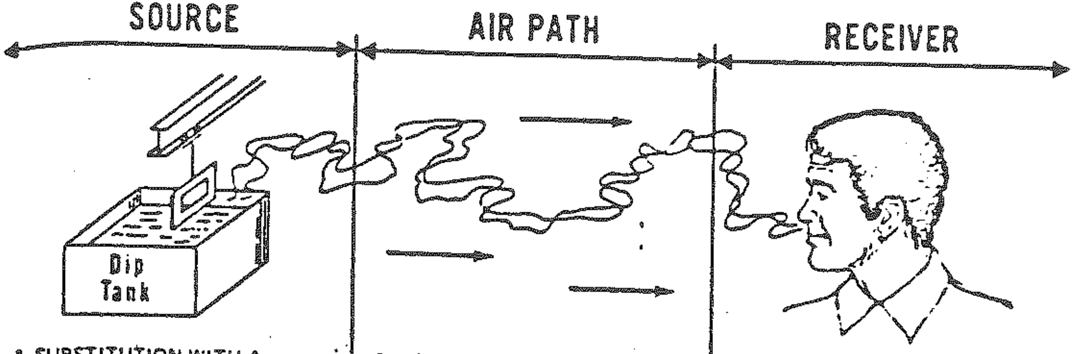
Lansing, Michigan 48909

GENERALIZED DIAGRAM OF METHODS OF CONTROL



SOURCE	AIR PATH	RECEIVER
1. SUBSTITUTION WITH A LESS HARMFUL MATERIAL (WATER IN PLACE OF ORGANIC SOLVENT)	1. HOUSEKEEPING (IMMEDIATE CLEANUP)	1. TRAINING & EDUCATION (MOST IMPORTANT)
2. CHANGE OF PROCESS (AIRLESS PAINT SPRAYING)	2. GENERAL EXHAUST VENTILATION (ROOF FANS)	2. ROTATION OF WORKERS (SPLIT UP DOSE)
3. ENCLOSURE OF PROCESS (GLOVE-BOX)	3. DILUTION VENTILATION (SUPPLIED AIR)	3. ENCLOSURE OF WORKER (AIR CONDITIONED CRANE CABS)
4. ISOLATION OF PROCESS (SPACE OR TIME)	4. INCREASE DISTANCE BETWEEN SOURCE AND RECEIVER (SEMI-AUTOMATIC OR REMOTE CONTROL)	4. PERSONAL MONITORING DEVICES (DOSIMETERS)
5. WET METHODS (HYDRO BLAST)	5. CONTINUOUS AREA MONITORING (PRE-SET ALARMS)	5. PERSONAL PROTECTIVE DEVICES (RESPIRATORS)
6. LOCAL EXHAUST VENTILATION (CAPTURE AT SOURCE)	6. ADEQUATE MAINTENANCE PROGRAM	6. ADEQUATE MAINTENANCE PROGRAM
7. ADEQUATE MAINTENANCE PROGRAM		

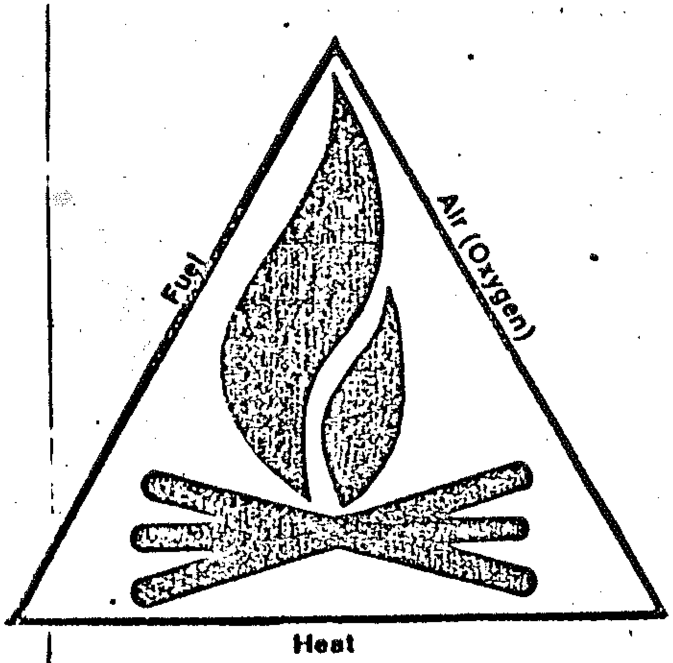
FIGURE 20-1.—To determine the extent of exposure, locate the contaminant source, the path it travels to the worker, and the employee's work pattern and use of protective equipment.

Kinds of Protective Equipment

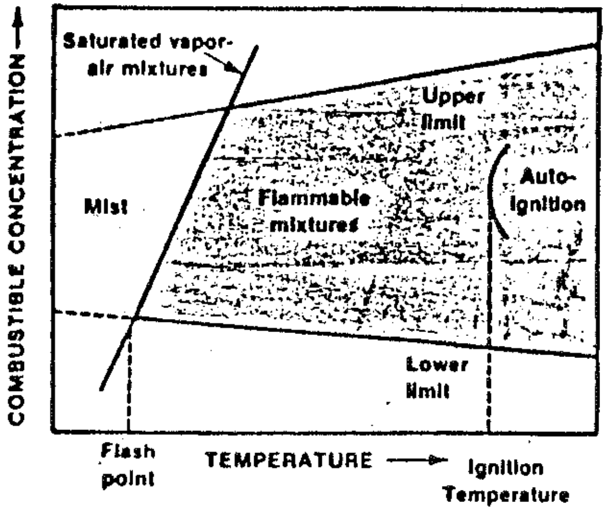
There are two broad categories of protective devices: protective clothing and respiratory protective equipment. Though there are far too many different kinds of items to cover them all in this handbook, a few things can be said about the two basic categories:

- Protective clothing is meant to keep dangerous materials from coming into contact with skin, eyes, and other parts of the body. Some items — rubber boots and aprons, for example — are totally impermeable and let nothing get through to the body surface. Other articles — your ordinary work clothes, for instance — let the air get through but keep out much of the dust and soil.

- Respiratory protective devices are breathing machines. Some devices are meant to supply you with air through a mask and hose where there is none to breathe in your work area or where the air is too dirty to breathe. Others are designed to filter out contaminants by various methods.



Fuel, oxygen, and heat must be present at the same time for a fire to occur.



Effect of Temperature on Limits of Flammability of a Combustible Vapor in Air.

BASIC CONCEPTS

Most fires are the result of a chemical reaction between a fuel and the oxygen in the air. Materials such as methane, wood, coal, oil, grease, rags, and many plastics will burn when ignited in the presence of air. In each case, three ingredients are needed for an ordinary fire to occur: fuel, oxygen, and heat.

The Fire Triangle

These three ingredients (fuel, oxygen, heat) must be present at the same time for the fire to occur. If any one is removed, the fire will go out; more important, if one is missing, the fire will not start. A triangle can be used to illustrate this basic principle. Each side of a triangle is given one of the labels: fuel, oxygen (or air), or heat. If any one is removed the fire goes out.

Classes of Fires

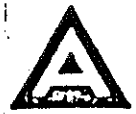
For firefighting purposes, fires are now classified into four groups:

Class A those that involve ordinary combustible materials such as wood, coal, plastics, paper and cloth. They are best extinguished by cooling with water or by blanketing with certain dry chemicals.

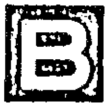
Class B those that involve vapors above flammable or combustible liquids such as gasoline, diesel fuel, kerosine, and grease. They are best extinguished by excluding air or by special chemicals that affect the burning reactions.

Class C those that involve combustible materials in electrical equipment. They are extinguished by nonconducting extinguishing agents such as carbon dioxide and certain dry chemicals.

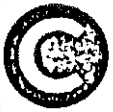
Class D those that involve combustible metals such as magnesium, titanium, zirconium, sodium, and potassium. They are extinguished by special extinguishing agents designed for such applications.



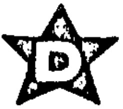
Class A Ordinary combustibles [wood; coal; paper]



Class B Flammable liquids [gasoline; diesel fuel; kerosene]



Class C Electrical



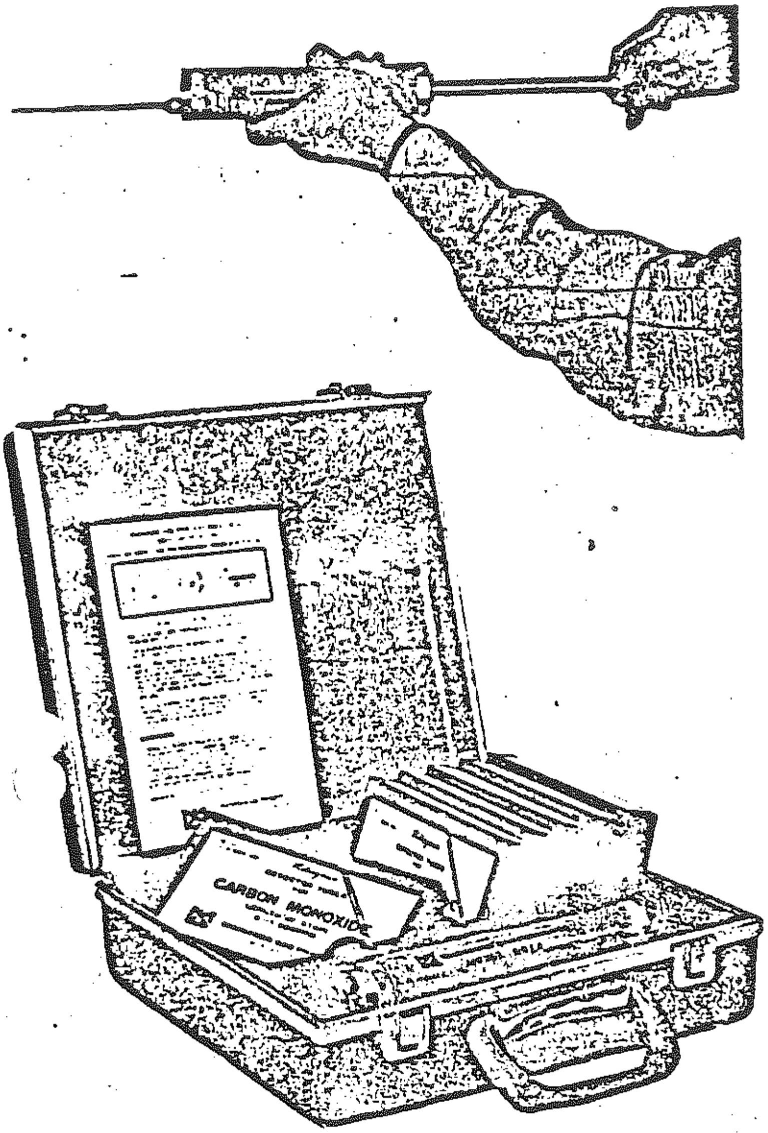
Class D Metals [magnesium; titanium]

Extinguishers are now labeled with special color-coded symbols (A, B, C, D) to indicate the class or classes of fires on which they can be used.

Class A - green triangle
Class B - red square
Class C - blue circle
Class D - green star

Toxic Gas Detector

Matheson-Kitagawa Toxic Gas Detector



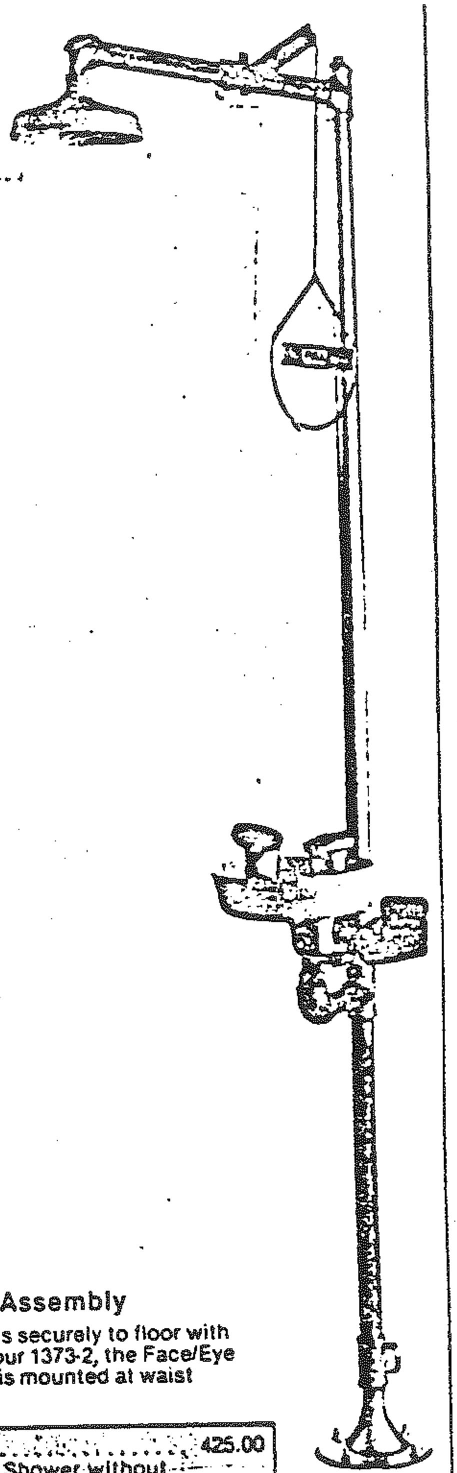
- Simple to use — easily operated by non-technical employees.
- Portable — lightweight, compact unit in a high impact plastic carrying case.
- Precise — the precision sampling pump is the key to accurate results using Kitagawa detector tubes.

An accurate and inexpensive method for determining the level of toxic vapors in lab or plant. Gives on-the-spot results to eliminate the need for expensive monitoring systems. Simply draw in a sample of the atmosphere through the detector tube and determine the concentration by comparing color changes within the tube. Detector comes in sturdy, high-impact carrying case with accessories and space for carrying detector tubes. Detector tubes are available for a variety of toxic vapors and come packaged in box for 10 tubes unless otherwise indicated. Pump is NIOSH Certified. Detector tubes are direct reading.

B1446 [illegible] 165.00

Emergency Showers

Emergency Showers



Shower/Face Wash Assembly

This assembly mounts securely to floor with a 8" floor flange. On our 1373-2, the Face/Eye Wash (same as 1368) is mounted at waist height.

B1373-2 [illegible] 425.00
B1373-3 Drench Shower without Face Wash Assembly 235.00

*Medical and industrial experience have shown that the optimal first aid prior to medical treatment for chemical splash consists of a 15 minute flushing of the injured part of the body with water with clothing removed. Safety showers must be within 10 seconds or 100 foot travel distance of a hazardous area (newly developed ANSI standard Z358.1). Where extremely hazardous conditions exist, showers should be located 10-20 feet from the source of hazard. Consult a physician for recommendation.

Sample Procedure
For
Entry Into Confined Spaces

I. Definition

A confined space is any relatively small enclosed or restricted space without proper life supporting atmosphere or in which mobility is restricted, such as, but not limited to; a bin, furnace, cupola, tank, pressure vessel, vault, well, boiler, or small compartment of a ship.

II. Training

All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, including prior testing and purging if needed, the use of required protective and emergency equipment, and proper procedures for entering and working in such areas.

III. Lockout

Prior to any employee entering any confined space, controls to equipment supplying or operating the device to be entered, or any device contained in the space, shall be locked out, valves to supply pipes serving the device or any device within the space shall be locked out or blanked, and any sewer or drain lines serving the space shall be blanked.

IV. Testing

Before an employee is permitted to enter a confined space, the air in the space shall be tested with an approved device to determine if there is a deficiency of oxygen, the presence of toxic gas or vapor in excess of maximum allowable limits prescribed by the Department of Public Health, or an explosive atmosphere.

V. Precautions

A. An employee shall not enter a confined space having an explosive atmosphere unless involved in correcting a condition which caused the explosive atmosphere and the condition cannot be corrected by any other means and the atmosphere cannot be purged below the explosive limit. All sources of ignition shall be prohibited in or around the space.

B. If the atmosphere in the space is found to be either oxygen deficient or toxic, either ventilation shall be provided in a quantity that eliminates the hazard or respiratory equipment prescribed by the Department of Public Health shall be worn.

C. A lifeline and safety harness shall be worn by an employee entering a confined space. These shall be so attached that the employee's body cannot be jammed in a small exit opening.

D. Another employee trained in rescue procedures and equipped with the means necessary to effect a rescue shall be stationed outside the confined space in a position to watch the employee inside the space.

E. If rescue efforts would involve lifting the employee vertically to remove him from the space, then a second employee must be in the immediate vicinity to assist the employee stationed at the entrance to the space, or a mechanical means to lift the employee out of the confined space shall be provided before work starts.

F. Confined space entry procedures should be posted at the entry of each confined space or other appropriate locations subject to entry by employees.

For MIOSHA safety standards covering confined spaces refer to construction standard Part I, Rule 112, General Industry Standard Part I, Rule 16 and Health Standard Rules 3301 and 6402.

Say yes to Michigan!

and a safer workplace

MICHIGAN DEPARTMENT OF LABOR
SAFETY EDUCATION AND TRAINING DIVISION
7150 HARRIS DRIVE, P.O. Box 30015
LANSING, MICHIGAN 48909

517/322-1809

SET FORM #2046

CONFINED SPACE (kən-fīn′ed, spās) N.

"Confined space" means a space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks; process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth, such as pits, tubs, vaults, and vessels.

FORD-ALLEN PARK CLAY MINE LANDFILL
EPA I.D. #980568711

Hazardous Waste Employee Training Schedule

Personnel Listed Have Worked Or Are Available To Work At The Facility

Employee		Training Date					
Abernathy, Jim		5/16/81	4/5/83				
Adamson, Jim	Operating Engineer	5/16/81					
Bannerman, Marvin		5/16/81	4/5/83				
Barkman, Al		5/16/81					
Bowers, Kathy		4/5/83					
Bridges, L.		4/7/83					
Briggs, Bob		5/16/81					
Brennan, Jim	Foreman - Inspector	[illegible]	4/5/83	[illegible]	[illegible]		
Cieslak, Joe	Manifest Checker	4/5/83	2/8/84				
Cummings, Bill	Operating Engineer	5/16/81					
Curry, Chuck		5/16/81					
Cusenza, Dave		5/16/81	4/5/83				
Davis, Pete	Foreman - Inspector	4/5/83					
Fain, R.		4/7/83					
Gracey, Dale		5/16/81					
Hawthorne, Allen		5/16/81	4/5/83				
Hayes, Mike		5/16/81					
Jasso, L.		4/7/83					
Johnson, Lowell		5/16/81	4/5/83				
Knox, Willie	Operating Engineer	5/5/83					
Oliverrio, Tony		5/16/81	4/5/83				
Rank, L.		4/7/83					

Employee		Training Date					
Ray, Ann	Manifest Checker	4/5/83					
Richardson, Virgil	Operating Engineer	4/5/83					
Smith, Ray		5/16/81					
Strong, Murry	Operating Engineer						
Swiencki, Dave							
Sule, Ron	Manifest Checker	4/7/83	3/7/84				
Van Houten, Al							
Walker, Murry	Operating Engineer	10/5/82	10/5/83				
Weingartz, John	Operating Engineer	4/7/83	3/7/84				
Wujek, Dan	Manifest Checker	7/19/83	12/5/83	[illegible]			
Ferrantino, Mike	Foreman - Inspector	2/8/84	3/7/84				
Evans, Stanley		3/7/84					
Dominski, Robert		3/7/84					

H-1c Training Director 40CFR 264.16 (a) (2)

The Ford Motor Company Training Program has been provided to date by the Facility Training Director, Mr. David S. Miller. Mr. Miller received his B.S. degree in geology from the University of Michigan in 1977 and has been involved with hazardous waste management since the effective date of the RCRA regulations. His experience in this field is as follows:

1980 - 1981	Environmental Coordinator for three hazardous waste treatment facilities. Developed facility operational, recordkeeping, and training procedures in compliance with RCRA and Michigan PA 64.
1981 - 1984	Environmental Coordinator for the APCM landfill. Developed operational, recordkeeping, and training procedures in compliance with RCRA and Michigan PA 64.

H-1 d Relevance of Training to Job Position 40CFR 264.16 (a) (2)

The job descriptions and job training program indicate that the training provided is relevant to the job position.

H-1 e Training for Emergency Response 40CFR 264.16 (a) (3)

Emergency response training is provided as shown in section H1-b.

H-2 Implementation of Training Program 40CFR 264.16 (b)

Documentation of the training provided is included in the facility notebook. Examples of such documentation are as Attachment 22.

Attachment 22

DOCUMENT OF HAZARDOUS WASTE TRAINING

ANNUAL REVIEW

Training Session Date: 10-05-83

Place: Job Site

Trainee: Murray D. Walker
Ford Motor Company Employee

Previous Experience: Twenty-one years of experience as landfill bulldozer operator. Previously handled all wastes at the landfill prior to Act 64.

Aspects of Training: Waste characteristics and their physical properties were discussed in detail. General inspection items and procedures including waste verification were discussed. Pertinent waste handling and disposal regulations, particularly the management of run-off and run-on were addressed. Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures were discussed along with safety procedures and procedures for using, inspecting, repairing and replacing emergency and safety equipment. Fill and grading procedures for the site were studied.

Training Director: David S. Miller - Rouge Steel Company

Murray D. Walker

Attachment 22

DOCUMENT OF HAZARDOUS WASTE TRAINING

Training Session Date: 05-05-83

Place: Job Site

Trainee: Willie B. Knox
Ford Motor Company

Previous Experience: Three years of experience as landfill bulldozer operator. Previously handled all wastes at the landfill prior to Act 64 as the alternate operator. Fourteen years experience as heavy equipment operator for Company.

Aspects of Training: Waste characteristics and their physical properties were discussed in detail. General inspection items and procedures including waste verification were discussed. Pertinent waste handling and disposal regulations, particularly the management of run-off and run-on were addressed. Spill and Accident Prevention Plan, Contingency Plan and Emergency Procedures were discussed along with safety procedures and procedures for using, inspecting, repairing and replacing emergency and safety equipment. Fill and grading procedures for the site were studied.

Training Director: David S. Miller - Rouge Steel Company

Willie Knox 5-17-83

Attachment 22

Certification of Training

Facility ID: Wayne Disposal, Inc. MID 048 090 633

Employee Name: JOSEPH CIESLAK

Employer: WAYNE DISPOSAL

Job Title: MANIFEST CHECKER

Course: 55

Program Elements:

*1. Hazardous waste rules & regulations; what is hazardous waste; chemical & physical properties.

2. Discussion and use of appropriate safety and emergency equipment.

3. Review and discuss all elements of contingency plan & emergency procedures.

4. Review and discuss facility inspection reports.

5. On going training of professional and supervisory personnel with respect to regulations changes and/or the up grading of job related skills through professional development programs such as conferences, seminars or course work.

[✓ 6.] Toxic & physical effects of hazardous substances including routes of entry into the body and dose/response relationship.

7. Update on contingency plan & emergency procedures.

I participated in a training program on 2/8/1984 covering the following topics referenced above:

Elements: 6.

(Signature) Joseph Cieslak

Michigan Hazardous Waste Industry Training Program
Director: Mike Tillotson